

CHEMICAL & METALLURGICAL ENGINEERING

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November 29, 1922

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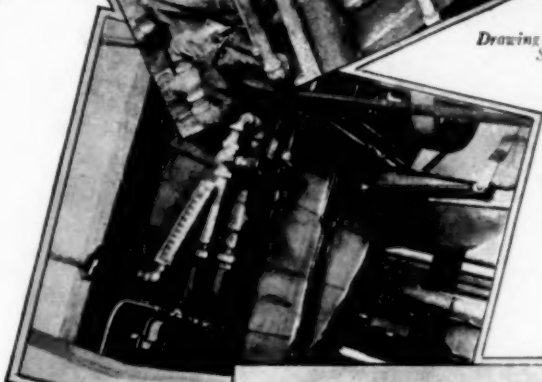
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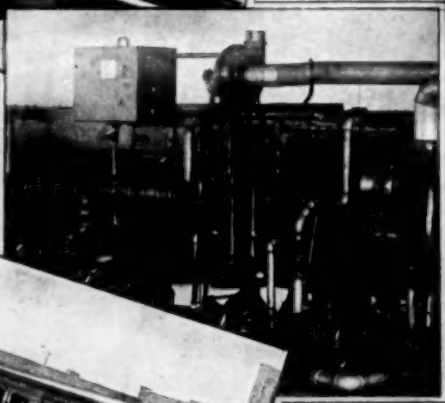
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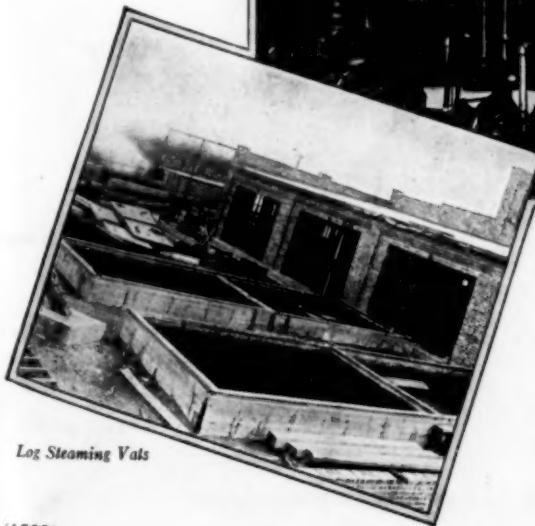
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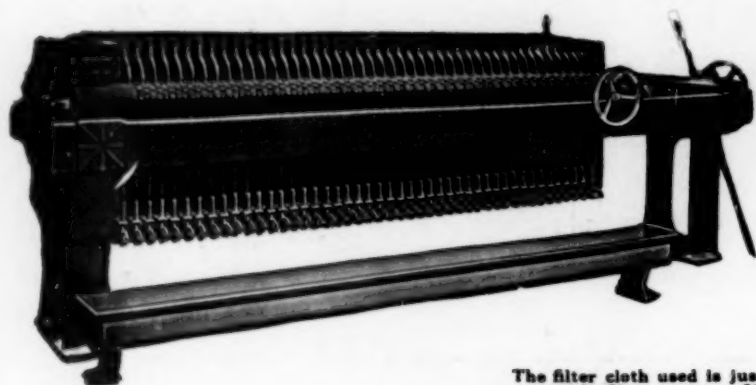
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Your Support Is Solicited

SEVERAL current developments in Washington are competing for the attention of the chemical public. The Tariff Commission has already begun to unravel the knotty problems involved in the flexible tariff provision on chemicals. The State Department, apparently, is still scheming with dyes and reparations, while Congress and the Internal Revenue Commissioner continue to play football with industrial alcohol. But with these issues furnishing the pyrotechnics, there is a less spectacular development in the Commerce Department which is likely to be overlooked. Our reference is to the rather faltering progress being made by the new chemical commodity division in its efforts to serve our industry.

Four months ago, when the chemical division was organized, we naturally expected great things from it. There appeared to be a definite need in our industries for co-operative study of export problems, foreign markets and competition, and of such domestic questions as standardization, trade statistics and cost finding. The man put in charge of the work was admirably fitted for it, and the different branches of the industry through associations and individuals pledged him their support. In the short time he held that position Mr. DELONG accomplished considerable, but it is now evident that his work was severely hampered. In fact, the meager appropriation allowed the chemical division practically prevented it from filling its true function of constructive service. With but \$10,000 for personnel expenses during the present fiscal year, and that to be distributed among two chemists, a clerk and a stenographer, it is evident that the possibilities for startling accomplishments were definitely limited.

But the chemical division is facing a second predicament. Its former chief, Mr. DELONG, has now returned to the Tariff Commission, where his services and experienced judgment were sorely needed in connection with the administration of the new tariff law. To find a successor with a sufficiently broad experience in the chemical industry and at the same time qualified to deal with its foreign trade problems has been one of the Commerce Department's most difficult problems and as yet one that is far from being solved.

It would seem, therefore, that there are two things to be accomplished and for which those in charge may quite logically look to the chemical industry for a helping hand. First and of more immediate importance is the appointment of the division chief. Such a man should know the chemical industry thoroughly, particularly from the business viewpoint; he should be a good organizer, something of a diplomat, and, most important of all, possessed of a generous supply of common sense. In addition, the Commerce Department is anxious that

the man should have some experience in foreign trade, but it is our opinion that this is not nearly as essential as a good grounding in the chemical industry as a domestic business. Surely, somewhere a man of these qualifications is available, and we in the industry would be unmindful of our duty if we did not help the department in making this important appointment.

Our second obligation is in the matter of support—financial and otherwise. If the Bureau of Foreign and Domestic Commerce is granted an increased appropriation for the next fiscal year, funds can be made available for strengthening the chemical division so that it can function effectively in serving the chemical industry. Lending approval to Mr. HOOVER's request of the Congressional Appropriations Committees, therefore, is merely an effort in our own behalf. And in the meantime the industry should continue to stand squarely behind the work of the new division. Its measure of service will depend primarily on whether or not it receives the indorsement and hearty co-operation of all branches of the chemical industry.

Combating Tuberculosis

HEALTH hazards in the chemical industry are usually so definite and well recognized that proper precautions are taken against them. Of a more insidious character, however, and consequently not so thoroughly appreciated is the menace to industry as a whole of the ravages of tuberculosis. Many diseases to which the human animal succumbs take their toll only in the later years of the average span of life. Tuberculosis, on the contrary, is essentially a disease of the producer, for 80 per cent of the deaths from this cause occur in persons between the ages of 15 and 44.

There is a definite personal obligation on executives and technical men in industry to give thought to this industrial health hazard. Enlightened leadership in the elimination of the scourge is afforded through the National Tuberculosis Association, which makes its annual public appeal at the holiday season through the sale of Christmas Seals. There is little need here to describe the splendid work of this association in educating the public to better hygiene or to quote the astounding results achieved—results which in many places have cut in half the mortality from tuberculosis. But it is appropriate and vital for men intimately associated with industry to remember that the wage earner is the most frequent victim of tuberculosis, and industrial leaders must be concerned with the health of the wage earner.

Exposure to dust, smoke fumes and poisonous chemicals as well as poor lighting and ventilation and long hours of labor, all have their effect in undermining the health of the worker and reducing his resistance to

disease. Technical men in many industries have control over these working conditions and should exercise a vigorous, intelligent and sustained effort toward improvement. While this is humanitarian, it may also be regarded as almost selfish, for it has been proved time and again that money invested in improving the health of the worker is more than balanced by a decrease in labor turnover, spoilage of product and lost time due to illness, and by a distinct increase in per capita production. Of all this we are reminded, annually at least, by the appearance of the Christmas Seals, inviting our support for a movement that in the end brings a definite benefit to industry.

An Opportunity for

The Fertilizer Division

AT NO TIME in its history has the fertilizer industry needed as much as it does today constructive thought for its highest development. In many respects it stands on the threshold of a new era. Among the agencies that should be making a regular contribution to its progress is the fertilizer division of the American Chemical Society. Representing as it does not only individual chemists of recognized merit but also our largest chemical society, it is in an unusually fortunate position to render service. There is a feeling, however, backed by some evidence, that the division is altogether missing its opportunity.

The program of the recent A.C.S. meeting in Pittsburgh included a series of titles for papers in the fertilizer division that was most impressive. Particularly the group of papers in the symposium on "The Modern Trend of the Fertilizer Industry" promised to be of great interest and value. Performance, however, fell far short of the promise. The forenoon meeting was devoted almost wholly to papers on analytical chemistry in the fertilizer industry, which were presented at painful length and in much greater detail than the circumstances justified. The afternoon session, which was to include the symposium, suffered even more acutely by the fact that only two of the six speakers in the symposium were present. Of the remaining four papers, two could not be presented at all because neither author nor paper were on hand. Finally, the attendance at this meeting apparently reached low water mark, with an average of less than a dozen for each session.

Three specific criticisms grew out of this meeting, all of which can be profitably considered for the future. First, it has been argued that, on account of the small attendance and the apparent lack of interest, the division should be disbanded. Second, the discussion of analytical methods, while not wholly out of place in the fertilizer division, is not worthy of as much attention as it has received. Third, it was said in some quarters that the division was not going to the root of things, and was playing around on the fringe of an important subject in a way that looked as though it was trying to suppress criticism of the industry.

With the first of these we are not in sympathy, although we should be so inclined if we felt there were no hope for improvement. The fertilizer industry is more and more engaging the attention of competent chemists and engineers and is getting out of the realm of rule of thumb into that of scientific control and operation. Consequently the A.C.S. division should enlist the active co-operation of a large number of important men. The industry already has some excellent

leaders, and more good chemists are constantly entering the field. There is need for the division.

Attendance, however, will depend in large measure on the program, which leads us to the second item of criticism. Without decrying the importance of analytical methods, we think it fair to say that they are not the most vital things in the fertilizer industry today. However interesting they may be to those who have to use them, they are dry and tedious to others who have the larger problems of industrial development in view. The proper place for detailed study and debate on methods of fertilizer analysis is in the meetings of the Association of Official Agricultural Chemists. Methods must have their approval before they can be widely adopted. Consequently it is a waste of time to duplicate the work of that association in the fertilizer division of the A.C.S. In our judgment the discussion of analytical methods can well be left to the A.O.A.C. because, being organized for that purpose, it will handle the subject more sympathetically and effectively.

What then shall be the function of the fertilizer division? In our judgment it should discuss the larger aspects of the fertilizer industry as a whole; apparent trends in fertilizer manufacture and application; the future of the industry in 10 to 20 years, as indicated by the general development and the obvious limitations of the present processes and products; the chemistry of raw materials and the methods of treating them, with special reference to new developments; engineering and economic problems involved in the manufacture, transportation, storage and application of fertilizers. A discussion of these and many other similar subjects will give the impression that the division is going to the root of things, and will successfully dispel the notion that the industry wants to suppress criticism of its present methods and does not care to receive suggestions that involve radical changes.

On the whole we have the impression that it would be a backward step to disband the division. There is a vast amount of worth-while work for it to do; but we are equally certain that if it is to justify its existence it must give some thought to its highest functions and take steps to rejuvenate its membership.

The Wisdom Of Fulton

HANGING in a corridor of the Engineers' Club in New York is a document of historic interest, being ROBERT FULTON'S "estimate for the expense of a steam ferryboat for one year." The items are penned in a firm hand, and while the document as a whole shows the effect of age, the paper has not disintegrated nor has the ink faded to a noticeable degree. Dated January 22, 1810, the paper bears the autograph of the famous engineer and inventor.

It is not so much the actual cost of operating a steam ferryboat in 1810 that attracts one's interest today as he reads the specifications. They have long since lost their value or usefulness. Of course it is interesting to note that FULTON required two firemen who would "also act as engineers to keep the engine in order," and "two boatmen to take turns in steering." Fuel was required at the rate of "1½ cords of wood for 12 or 13 hours," while "ware tare and repairs" came in for substantial consideration.

But the significant item in the estimate, to one who has followed the trend of science in industry, is the fact

that FULTON had a clear appreciation of the value of trained men; for in commenting on the two firemen, he wrote, "they must be engaged for the year, as such men cannot be turned away in the winter and got in the spring." Chemists will warm to FULTON's sentiments and wish for more of his type in industry. This is particularly true of those who, in the past year, have been "turned away in the winter" of business adversity without even the certainty of seasonal employment "in the spring" of a business revival.

Punishment for The Innocent

ON November 6 the prohibition authorities at Washington issued a new ruling in regard to alcohol for rubbing purposes. Heretofore one of the principal denaturants for rubbing alcohols has been diethylphthalate. This is practically odorless, is a solvent for essential oils and makes alcohol completely unpotable. No one would want to drink it after his first "gulp." The new ruling which goes into effect December 6 requires that besides this "the denaturer shall add to each 100 gallons of the two specified formulas (39-A and 39-B), as now authorized, three-eighths of a gallon of approved benzol of the quality specified."

Now, benzol is not odorless; it has a definite and unpleasant smell, and is a poison recorded as the cause of many deaths. Of course three-eighths of one per cent is very little, but some persons are remarkably sensitive to it. In our issue for September 20 we published an article on benzol poisoning, its occurrence and prevention. The author said that benzol may be absorbed through the skin, but he doubted if this mode of entry presents a serious hazard in industry. This referred to benzol by itself. The mixture of benzol and alcohol, however, is more volatile than either of the two, and the solution will penetrate when benzol alone will not.

After diligent inquiry among the best authorities the only excuse we can get for the use of benzol in alcohol for this purpose is that it "probably" would not have a toxic effect in three-eighths of one per cent dilution. But this is far from a guaranty. Chemists familiar with the operation of tar distilleries tell us that mere contact with benzol frequently produces eruptions like boils on the skin. Dr. ALICE HAMILTON reported in 1916 that, from inhalation of the fumes alone, fourteen new cases of acute poisoning and seven deaths occurred. Here is a typical example of the effect on one who is sensitive: a benzol kettle had been empty 24 hours, was then washed out twice with steam and permitted to stand filled with water over night. As a workman went into the kettle a strong stream of air was blown through it. Nevertheless he was overcome by the fumes. He was rescued, but one of his fellow workmen who merely assisted at the rescue was also overcome, and died within 10 minutes. Not only are persons supersensitive to this poison but those in bad health have also been observed to be especially susceptible to its dangers. There are plenty of instances of a similar nature. Benzol poisoning is a serious industrial hazard.

All nurses are trained to give patients an alcohol bath, especially in cases of fever. Denatured with diethylphthalate it has been tried and found acceptable. But to add benzol with all its hazards to this universal solvent, when its potency is increased by such a solution, and to threaten the sick and afflicted with its poisonous consequences, seems to us clear beyond the province of the prohibition authorities.

Home Tanning and The Leather Industry

WITHIN recent years the Department of Agriculture has received more than 20,000 inquiries regarding methods of home tanning. The reason for these requests, which often arrive at the rate of twenty-five to fifty a day, is not difficult to find. The disposal of a single hide or a few hides by a farmer or country butcher presents a marketing problem which often attracts more attention than other similar instances because of the opportunity for direct observation of the spread between the prices of raw material and finished product. Thus a farmer may have a single hide which he considers of excellent quality and yet be unable to dispose of it except to a junk dealer, from whom he may receive \$1. About the time of this transaction he may have occasion to buy some leather and find he must pay anywhere from 90 cents to \$1.50 per pound at retail. Small wonder that his first thought is to do his own tanning!

This feeling will continue as long as the farmer fails to understand thoroughly the factors that make the situation possible. As the total domestic supply of hides and skins falls short of the demand, it would seem as though there should be no trouble in marketing country hides, which constitute from 20 to 50 per cent of domestic production according to kind. But all too frequently these hides have been taken off in a careless manner and improperly cured so that they are naturally worth much less to the tanner than packer hides which have been removed by experts, thoroughly cured and carefully graded. The tanner's efforts are attended with enough difficulties even when working with uniform raw materials. There is little excuse for the farmer's failure to understand these points, for the whole subject of skinning, curing and marketing has been thoroughly covered by the Department of Agriculture in Farmers' Bulletin 1055, which may be had for the asking. As for the possibility of reducing the price spread between country and packer hides, the essential requirements have been summed up in a recent bulletin of the National Leather and Shoe Finders' Association as follows: "Unless farm organizations, working with the Department of Agriculture, can develop a plan by which country slaughter can be done by experts, sorted by experts and marketed from central points in carload lots, it will be otherwise impossible for country hides to be marketed in competition with packer hides."

Another point which the average farmer fails to appreciate is the increase in value during the conversion of the hide into leather. In this connection it seems probable that the circular on "Home Tanning" which has been prepared by the Department of Agriculture in response to the demand previously noted will prove of real value. At first sight it would seem that a pamphlet containing such information would tend toward the establishment of thousands of miniature tanneries which would be highly undesirable from an economic standpoint, even though the competition might not be felt by the tanning industry as a whole. Indeed, the bulletin points out alternatives which under normal conditions should prove more advantageous than attempting to tan one or two hides. But it seems more likely that the farmer who has the patience to follow through the entire process will gain an understanding of the tanner's problems which could be obtained in no other way—an understanding that will go far toward eliminating the present feeling of dissatisfaction.

Readers' Views and Comments

Why Not Get Away From Traditions?

To the Editor of Chemical & Metallurgical Engineering

SIR:—The failure of one industry to avail itself of the technology of another is puzzling to engineers whose practice carries them into several fields of industry. This is explainable by conditions that lead to a state of "inbred talent" and which produce a mental state that does not permit of receiving impressions from without. There has grown a condition of self-satisfaction, or of mental inertia, that persists until the force of competition moves the management to a change of practice.

Many a business is retarded by the fact that a piece of equipment *works*. It has been developed by a process of addition and subtraction, or, as some one has said, "by guess and by gosh," until a fair degree of success has been attained; then the inbred talent rests and beholds this *ne plus ultra*, and refuses to progress further.

Sometimes, however, the check to development is given by the operator who, because the apparatus is successful from his point of view, does not wish to "experiment" and adopts a let-the-other-fellow-do-the-experimenting attitude, in spite of the fact that the "experiment" is not an experiment at all, but only the adaptation of the successful practice of another industry.

While we occasionally see an apparatus or a structure that is barely standing up, the trend is in the opposite direction, sometimes because of the lack of design data, but much oftener because of inability to design. The result is a job that costs much more than it should because the "designer" worked after a fashion that is called "playing safe." The subjects of heat transfer and thermodynamics are somewhat involved and to some people extremely abstruse, so that when

called upon to produce a design there is a temptation to "play safe" and the product is a monstrosity.

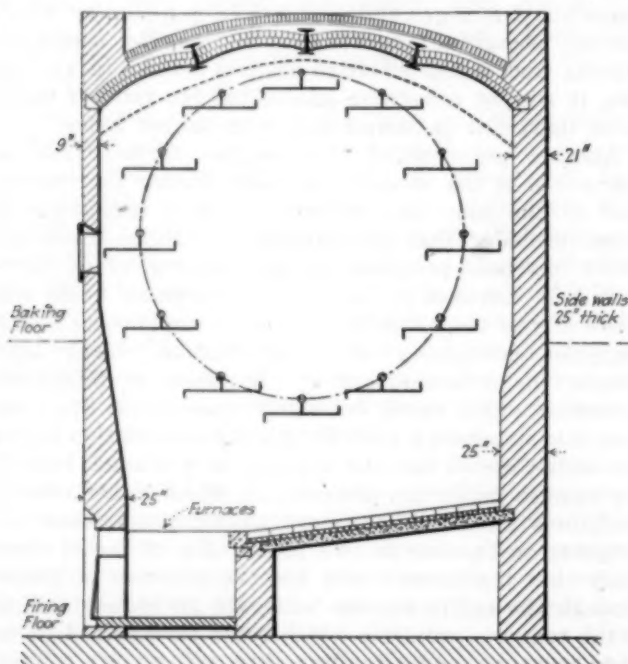
The figure shows a section of a reel oven such as used by the bakers of crackers, cookies and the like. The front wall is 9 in. and 25 in. thick; the back wall 21 in. and 25 in. thick, and the side walls 25 in. thick. The roof is formed by four arches sprung between steel I-beams and the front and rear walls. The top of these arches is covered with ashes, asbestos and a layer of brick. Two furnaces serve the oven; this to get a uniform distribution of the heat across the oven.

Being struck by the thickness of the walls and noting that they had no particular structural significance, I concluded that their principal function was the conservation of heat. Being desirous of reducing the weight (because these ovens would be installed in the upper stories of an old building, necessitating a new and heavy supporting structure), I suggested that a course or two of insulating brick be used, thereby permitting thinner walls and a consequent great reduction of weight. The representative of the manufacturer then assured me that the thick walls were not for the purpose of heat conservation but for heat storage (regeneration). The heat-regenerative value of thick walls, heated on one side only (not checkerwork) at a temperature of less than 600 deg. F., must be slight; and were this the main function of the brickwork, the thickness need be no greater than a single course.

The four arches in the roof next attracted my attention. I wondered why a single arch (as indicated in the figure by the dotted line), which would be cheaper to construct and also of greater stability, would not serve better than the series of arches shown. I was informed that the roof with four arches gave better baking results, which was apparently attributable to the heat stored in the volume of hot gases occupying the approximately triangular space bounded by the front (and back) wall, the adjacent arch and the circle described by the shelves of the reel. A calculation showed that the gases occupying the entire volume of the oven, in cooling 100 deg. F., would give up the heat equivalent of less than a half pound of coke. The oven described bears evidence of having been designed by bricklayers who have had experience in building boiler settings. The wall thickness, however, is even greater than is the average practice in boiler setting—and the boiler settings carry much higher temperatures.

The processes involved in the foregoing are well known to engineers familiar with the development of industries. An apparatus or process with a nebulous beginning is developed by a process of evolution to a point where progress seems to stop. This is the *ne plus ultra*. Any suggestion that an engineer or chemist be employed with a view to improvement would be met with scorn. Has not the apparatus (or process) been improved from year to year, by men trained in that particular work? What chance has an outsider, unfamiliar with the industry, to improve on the practice of experts?

Instances of "outsiders" improving the practice of "experts" are too numerous to be set aside as "flukes."



SECTION OF OVEN

There must be a psychological explanation. Occasionally the operators of long experience are so steeped in the dogmas and superstitions of the business that they are blind to new principles or methods when they present themselves. The "outsider" will often come with a fund of experience gathered from other and somewhat similar lines of endeavor, and see at a glance opportunities for improvement.

About a dozen years ago I paid my first visit to a cement plant. One of the things I observed was a building over the full length of a number of rotary kilns. I asked the engineer responsible for the design, why the building was made to house the entire length of the kilns. His answer was, "To protect the kilns, of course." "But," I said, "the building is covered with corrugated steel sheets less than $\frac{1}{2}$ in. thick, while the kiln shells are $\frac{1}{4}$ in. thick—a case of the weaker protecting the stronger." "Well," said he, "they all do it."

C. O. SANDSTROM.

Kansas City, Mo.

Appreciation of the Engineer

To the Editor of Chemical & Metallurgical Engineering

SIR:—This appreciation of the engineer, from an editorial in the November *Current Opinion*, deserves wide circulation for its clear exposition of the engineer's position in, and duty to, organized society.

Cornell, Wis.

ALLEN ABRAMS.

The Engineer

What the world needs is engineering. What has impeded the progress of the world has been its theorists, metaphysicians, philosophers, theologians and other speculators and hair-splitters.

An engineer is a man who takes a force and finds out how to work it that he may do some good to the race. This is much more to the point than speculating where the force came from, what is its nature and where it is going to.

We need the engineer in politics. The Socialist and every other kind of an ist are merely dealing in riddles. An engineer deals with facts. Instead of constructing some fine-spun theory about government, he would take people as they are and the laws of nature and of business economics as they are and try to work out something from them that would do good to humanity.

We need the engineer in religion. Religion deals with moral force. It is vastly more important to set this moral force to work, to learn its laws and to operate it for the communal good than it is to find out where it came from.

We need the engineer in the schoolroom. Instead of puzzling with theories of education, we should take the child as he is and try to make something out of him.

We need the engineer in the business world. Whenever a man begins to talk about capitalism or labor you may know he is up in the clouds. Really there is no such thing as capitalism nor as labor. These are artificial abstractions—mere counters to argue with. The real things are human work and human welfare. Work is the energy of living people and capital is the stored energy from dead people.

And there is but one problem, and that is how to manage these two forces of energy in a way to produce the most human welfare.

Some day we are going to kick the speechmakers, flag-wavers and phrase-makers out of our legislative bodies and elect engineers who will address themselves to the problem of running the country.

And some day our schools and churches will likewise be put into the hands of practical engineers who shall produce results.

EDITOR'S NOTE:—We agree with our correspondent that this is an exceptional appreciation of the engineer from an unexpected source. There are some conspicuous examples of engineers filling the needs to which the editor of *Current Opinion* refers. In politics, or rather

in public life, we have Mr. Hoover, Secretary of Commerce, and Mr. Caetani, lately appointed Ambassador from Italy. In religion we recall no engineers who are following that vocation, although recently Dr. Steinmetz was a distinguished lay-preacher in a series of religious talks by laymen at Schenectady. In the school-room examples are more numerous, as they are also in the business world. The ability to achieve results seems to be the quality that attracts the public to these men.

Tests on Bearing Metals

To the Editor of Chemical & Metallurgical Engineering

SIR:—"Tests on High-Tin Bearing Metals," by P. W. Priestley, in your issue of Nov. 8 has reopened a very interesting subject.

Bearing alloys have received a great deal of attention by many investigators, but the technique of "testing" has not been standardized, because too many factors (only partly metallurgical) enter into such investigations. Lacking a well-established basis of comparison for any product of the metallurgical industry, we shall always find a large number of producers that make grossly exaggerated claims for their "secret compounds." Unfortunately, this patent medicine situation has existed for many years in alloys for bearings, solders and other specific purposes.

Bearing alloys have so far eluded definite testing methods because great difficulties surround this problem. The "efficiency" of bearing metals is not solely a question of metallurgy, but is also one of mechanical engineering, of physical chemistry and of lubrication. The testing of bearing metals is undoubtedly the most difficult problem in the art, being equaled only by the problem of determining the cutting efficiency of tool steels.

In order to investigate systematically a series of bearing alloys, quite a number of laboratory tests must be carried out, to detect any basically faulty materials. Such preliminaries often eliminate the necessity of further commercial tests. Among the laboratory tests are:

1. *Microstructure of the Alloys.* This is required to determine, first of all, whether the basic requirements of a bearing alloy (a soft background with imbedded hard grains) are met. The "micro-character" and tentative scale of micro-hardness developed by the research sub-committee of the American Society of Mechanical Engineers will be found very useful. It will be quite important, I believe, to insure that the hardest grains in the bearing alloy are not harder than the shaft, so that the latter is not scored if the lubrication should fail.

2. *Elastic Limit Under Compression.* The Martens mirror extensometer can often be replaced by gradually compressing a cube of the alloy. One side of this specimen is prepared for microscopic investigation; it is continually observed, and the load determined at which the microstructure begins to change. However, the only certain method for determining the elastic limit which is of practical importance with bearing alloys is to determine the load at which a definite permanent set, say 0.2 per cent, takes place.

3. *Compressive Strength.* This test is usually carried out by compressing cylindrical specimens of the alloy until cracks appear at the surface of the specimen. This method suffers from a similar error as our standard tensile tests: the result is calculated on the basis of a cross-section undergoing progressive changes. The only

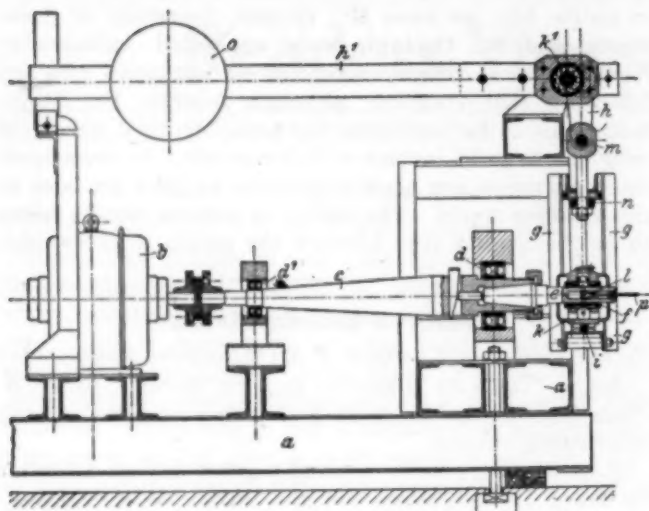


FIG. 1—KAMMERER'S TEST BENCH FOR JOURNAL BEARINGS

correct method of carrying out such tests is to establish curves in which the progressive increase of diameter of the specimen is shown against the increase of load.

4. *The Melting Point of the Alloy Should Be as High as Possible.* New lead-barium and lead-calcium alloys have a melting point of about 290 deg. C. (554 deg. F.). Since the lubricating material will give off penetrating odors before these temperatures are reached, an alarm signal is given before the bearings fail. If bearings are air-cooled as in moving railroad cars, such high temperatures cannot be reached; it will be of interest to note that such alloys permitted the German State Railways to run its trains successfully during the war without any lubricant whatever.

5. *Hardness.* While a knowledge of micro-hardness is very useful to determine the correct microstructure, the Brinell test (500 kg. load) will yield valuable information as to whether the alloy is in general suitable for its purpose. The Brinell test cannot, however, serve as a criterion of the comparative quality of such bearing alloys. Its largest value is to be found in controlling one definite alloy—each possesses highest efficiency at one certain Brinell hardness, and the engineer is thus in a position to determine conveniently whether a particular alloy is in its prime condition. The Brinell machine will also permit one to determine a figure which has considerable value in bearing alloys: the relation between the hardness unit, obtained by increasing the load at a determined rate to 500 kg. and then releasing immediately, and the hardness unit obtained on the same alloy by exposing a specimen to the maximum load for a period of 3 minutes. The figures thus obtained both at room and at elevated temperatures give information on the plasticity of the alloy, a property which largely affects its general efficiency.

Bearing alloys can best be investigated on a "test bench" similar to those used for automobile engines. According to my experience, the simplest and most useful is the one designed by Professor Kammerer at the Institute of Technology of Charlottenburg. Its construction is illustrated in Fig. 1. Shaft *c* runs in ball bearings *d* and *d'*, and is driven by a variable-speed motor *b*. The bearing *f* under test is pressed upward against the journal *e* by a lever system; the load can be adjusted by weights sliding on the lever arm *h'*. The machine and lever system is constructed with suspensions of spherical joints in such manner that the pres-

sure of journal against bearing surface is perfectly uniform. Thermometer *p* measures the temperature of the bearing during the test. The main factors of such a test are the pressure between shaft and bearing, the surface of bearing and the bearing temperature (which is influenced to a considerable extent by the former two and the nature of the lubricant). Tests are run systematically in series; after the bearings are "run in" at a definite load, the speed is increased from lowest to highest limit and the maximum temperature reached is determined in definite steps, say at 300, 500, 1,000 and 1,200 r.p.m. After the temperature no longer changes with time, the speed is again reduced to a minimum but the load increased by a definite amount. Then the speed is again increased by steps, and so to failure.

Such a test bench can be provided with simple attachments to reproduce adverse conditions often encountered in practice. For instance, an eccentric shaft may bear against the load lever, producing periodic pressure releases on the test bearing. Or a cam arrangement might be installed producing impact forces.

The importance of viscosity of a particular lubricant has been overrated. The usefulness of a lubricant depends upon the forces of adhesion to the metal and not upon the cohesion of the oil molecules to one another—i.e., its viscosity. Bare mention of this important point shows that the testing of bearing metals is not a purely metallurgical and mechanical problem.

At any rate it should not be difficult to standardize commercial tests for bearing metals by means of a simple test bench that anybody can operate and that is quite definite in its indications.

New York City.

HERMAN A. HOLZ.

Road Tests for Comparing Fuels

For the past 2 months, in conjunction with the Society of Automotive Engineers, American Petroleum Institute and the National Automobile Chamber of Commerce, the Bureau of Standards has been conducting a co-operative fuel research program.

The purpose of this work, according to a statement recently made by Major R. E. Carlson of the Bureau of Standards, is to obtain data which can be used as a basis for estimating the effect of change in gasoline volatility on the average fuel consumption of cars now in service throughout the country. The effect of these fuels on crankcase dilution, change in viscosity of the lubricating oil and ease of starting of the motor will also be investigated.

This co-operative fuel research program is still in progress at the Bureau of Standards and the form in which the results obtained will be published is a matter for final decision by the bureau and the three societies.

The personnel employed in these tests consists of representatives of the oil and automotive industries who have been loaned to the bureau and two representatives from the bureau to direct the work. In a problem of this sort where the results are of such far-reaching importance both to the petroleum and the automotive industries, it is of vital importance that the results be accepted at their true value when the program is completed. It is believed that the representation of both industries throughout the entire program of tests will greatly facilitate this acceptance of results because at all times both industries were entirely familiar with what is being done and how it is being done. Besides, these tests have been conducted by an impartial agency.

The Twelve-Hour Shift

A Discussion of the Present Status of This Great Problem and
a Review of the Report of the Federated American Engineering
Societies on the Twelve-Hour Shift in American Industry

BY CHARLES WADSWORTH, 3D

PERHAPS at the very beginning we should adopt a text which shall serve as the underlying theme of this discussion. It is from the introduction to the Federated American Engineering Society's report on this subject, which will be reviewed during the latter part of this article: "The desirability of abandoning the two-shift system lies not in its extent in industry but in the fact that the 12-hour day is too long when measured by twentieth-century ideas as to the proper conduct of industry. Economic considerations demanding a length of day which will give maximum production are influenced today by humanitarian considerations."

Thus we are shown to believe that the 12-hour shift should go. This article will deal with the reasons for the existence of the 12-hour shift, with the reasons why it has persisted in the face of great pressure, and with the two questions, so ably discussed in the report above referred to, the extent of the 12-hour shift and the remedies or substitutes which have been used to replace it.

There are in this problem three points of view which we should establish before we can understand the puzzle: The point of view of the public, that of the management or employer and that of the worker.

THE PUBLIC'S OPINION

There is still an unintelligent minority of the public who call to mind the concept of the farmer, with 16 hours of uninterrupted (?) work. They remark with conviction that the industrial worker is being babied anyway and that 12 hours is shorter than 16. Not a few employers feel that the industrial worker is being babied, but there will be relatively few whose views would coincide with that just mentioned.

A decreasing percentage of the public is uninformed on the 12-hour day. This is partly due to the strong artisan unions which have been universally successful in eliminating it from their trades; partly to progressive manufacturers who have successfully installed a shorter shift; but mostly, no doubt, to the widespread press publicity which is always given to the U. S. Steel Corporation and its decisions, changes and problems.

The vast majority of the public is passively opposed to the 12-hour working day. They wonder at its persistence and even professional investigators and reformers are puzzled. Everything seems to point to its speedy elimination and yet here it is. Why?

Part of the answer can be found in the employers' point of view and the rest of it in the laborers' attitude. These we shall try to make as graphic as possible.

THE EMPLOYER THINKS?

The manufacturer (or employer) who uses the two-shift (12-hour day) system has an attitude which varies between rather narrow limits. We can take as a basis for his attitude the background that the 12-hour day exists and *status quo* has great inertia. In his industry there probably has been until recently, and perhaps even yet, little sentiment against the 12-hour day. Grandfather or father (or if not his ancestors at least

his predecessors) used the two-shift system and nothing has called his attention to the necessity of changing it—neither public opinion, nor labor demand, nor yet law. So there is an understandable *laissez faire* background for his attitude. With such a base the attitude of the individual employer will be seasoned by the combination of a number of ingredients. There are many to whom progressive ideas are infrequent. Again, a larger number believe that the 8-hour day is much more expensive and any humanitarian impulse has been either still-born or strangled by commercial instinct. Of course this is no crime, but it is not progressive, and the question of whether the 8-hour day is more expensive is at least debatable. There are others who bow to the demand of labor for a 12-hour day! Yes, that's a fact, though it seems strange. Possibly there are other ingredients in the developed attitude of the individual employer, but these are the principal ones. So by properly balancing them we can construct a given employer's thought on the 12-hour day where it still persists.

The technical man in industry reflects the attitude of the employer. He must if he wants to butter his bread with salary from that firm. We heard of one man who objected strenuously to a labor wage reduction. "The men couldn't live on the reduced wage. It was unfair." His colleagues looked on the protest as foolish and with a kind of pained tolerance. His employer wished him farewell with the next pay check. So with enough exceptions to permit a healthy generalization the technical man's attitude on labor questions is necessarily a blind following of employer's views.

BUT WHY DOES THE LABORER STAND FOR IT?

Remember first that those workers who are still on a 12-hour shift basis are wholly unorganized and then reflect on these three stories which perhaps bring out the laborer's attitude better than an abstract description.

It was still night and the glare of the arcs was the only light on a rather wide street except for a few cheap restaurants. Every half minute a first cousin of the original Toonerville trolley bumped and rocked down the track toward the plant, filled to overflowing. One knew there was a plant there, for a bright bessemer flame said so. There were several. On the sidewalks a silent army plodded rather than walked, hundreds of them, thousands actually. There was some talk, sometimes a shouted sally and a retort. Then we turned off from the crowd to an interurban station which carried us to a nearby plant.

Back again at night and the interurban brought us in just as this same crowd was coming home. And if these plodded in the morning, they dragged now and there were no shouted sallies and no talk. Just a procession of tired out animals seeking only rest, food and those pleasures which satisfy without effort and which help to drown the dreary drudgery.

Such was the background for the answers that came to our question during some months of contact, "Why do you stick on this 12-hour shift work?" Three men can give answers which are typical of a vast majority.

Bill Brown was a Yankee who referred to all foreigners as "hunkies." All "hunkies" were either "pretty good hunkies" or " — — — — — ." He would have been over 6 ft. if he had not stooped. If he was on night shift, he got shaved Saturday afternoon before he went on to the 24-hour shift. (Twenty-four hours were necessary in order that each shift would work one week at night and one week in the daytime.) If he was on day shift, he got shaved Saturday evening after he came off for his 24-hour rest. Bill had a son doing "railroadin'" and a rather numerous family. He handed in a tax return of over \$2,100 in 1920. It was under \$1,500 in 1921, for the same work, 12 hours a day nearly every day in the year. "Oh," said Bill, "I get enuff to live on and I know the game. It's a hell uv a life, but what kin yuh do? No, I couldn't afford to work only 8 hours. — — — — — . Somebody'd haf tuh quit eatin'." You can translate it if you so desire. It means more to us as Bill said it.

Then there was Roman Bdfghijklmnpqr (it doesn't matter what his last name was) a bright-looking Slav of 25. A Ukrainian from farmer-peasant stock whose industry had commended him to his bosses and he was already a foreman. "Oh yes, I stay this country. Most my countrymen they come make money, go back. They buy farm. They live with nothing while they here. No, this factory job no good. Make you sick, but it pay good. You work like hell 10, 15 years—then you quit."

And finally there is Joe—"Boiler" Joe to distinguish him from a couple of other Joes in his gang. He has been in America 12 years and he knows three English phrases well enough to say them. Two of them are unprintable, the other is "No good." From somewhere in Russia where the Nordic strain is slender, stupid and dull, understanding English enough to grunt and nod when he is told to do something and to nod assent when someone answers for him. Already he has gone back with as many thousands as there were years of service. He had several times refused to work at all rather than go on an 8-hour job. Twelve hours or nothing! Thinking no more of America than an exploiter would think of the place where oil fields happen to be. The real reason why Americanization campaigns are stillborn and educational campaigns fail in some districts. America is a place to make money in and then return to God's country. These three men are common types, and it is not a far disproportion to assume that the 12-hour shift problem is two-thirds a foreign problem.

PRESENT STATUS OF THE PUZZLE

So we have the public largely passively opposed to the 12-hour day, but without a sufficiently active sentiment

to have anything crystallize; the manufacturer inactive principally because of the inertia of existing conditions, hesitant further because of the fear of greatly increased costs; and finally the laborer completely lacking organization, largely of foreign origin, regarding his work as a necessary penance for either a comfortable old age or for the "crime" of having to support a family, and for the most part either unable to find work at shorter hours or unwilling to consider it. Therefore the 12-hour day persists and to anyone who has lived in a 12-hour shift community the institution looms as a menace to civilization, for civilized living is impossible under it.

How Extensive Is This Menace

The report of the Federated American Engineering Societies discusses the extent of the 12-hour shift in American industries and some of the substitutes which have been tried in place of it. The study was made possible by a grant from the Cabot Fund and the work with which we are concerned was carried out by Horace B. Drury.

CONFINED TO CONTINUOUS INDUSTRIES

Mr. Drury points out that the 12-hour shift is confined almost exclusively to the continuous process industries and these in general belong to one of three types. The first type consists of those industries which employ high temperatures and cannot afford to let a large bulk of equipment cool off only to be heated up again the next day even if this were possible. There are of course many industries in which it takes days to heat up the equipment to a point where production is possible. These are called the heat process industries. To the second type belong those which, because of chemical reactions, cannot be stopped and started again, such as chamber sulphuric acid, soap saponification and hundreds of others. These are the chemical process industries. Finally there are industries in which the investment in equipment is extensive and the overhead charges would be prohibitively high per unit produced, if the work were not continued throughout 24 hours.

All of the men in these industries are not on 12-hour shift, of course, and an accurate estimate is impossible. Mr. Drury says that from 5 to 10 per cent of American industry is continuous process work and that from five hundred thousand to a million men are engaged in it. Those depending on the wages of these men will number close to two million persons. Finally, as nearly as can be estimated, about 300,000 wage earners work on the 12-hour shift. Thus the problem from its mere extent might not merit the attention it is receiving. But it has been justly condemned, and this condemnation has been increasing so extensively that it is not un-

SHIFT	MONDAY		TUESDAY		WEDNESDAY		THURSDAY		FRIDAY		SATURDAY		SUNDAY		HOURS PER WEEK
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
	6	12	6	12	6	12	6	12	6	12	6	12	6	12	
Shift A															62
Shift B															62
Shift C															56
Shift D															54
Shift E															54

FIG. 1—FIVE-SHIFT SCHEME WITH 9- AND 10-HOUR SHIFTS

likely to take the form of legislative action. What, then, are the industries affected and what remedies have proved successful?

METHOD USED IN OBTAINING DATA

Unfortunately there were practically no data available on this subject and it was necessary to accumulate the information by exhaustive field work. Mr. Drury's investigation could not of course be complete, so he has made it representative. He has investigated forty-four different industrial centers, among which are New York, Philadelphia, Chicago, Pittsburgh, Cleveland, Buffalo, Akron, Youngstown, Gary, Birmingham, St. Louis, Kansas City and Denver. In addition such localities as the southern New Jersey glass plants and the pottery plants near East Liverpool, Ohio, were also studied. He has grouped the continuous industries into four main groups indicated in the table below. We are of course primarily interested in groups I and II.

Group I. Iron and steel Non-ferrous metals Glass Cement Lime Brick Pottery	Group III. Paper Flour Rubber Breakfast foods Autos Textiles Mines
Group II. Heavy chemicals Fertilizers Explosives Dyes Industrial alcohol Wood distillation Refined corn products Soap Glue Drugs Sugar Electrochemicals Petroleum Salt Cottonseed oil and other oils	Group IV. Power Gas Water Ice Shipping Railroad Street railways Telegraph Telephone Mails and express Policemen Firemen Watchmen

How Much Will the Three-Shift System Increase Labor Cost?

Already the estimated extent of the 12-hour shift has been given. There are nine other questions dealing largely with the change from the two-shift system to some other operation plan. Therefore a brief discussion of these alternatives is appropriate. Perhaps the most obvious and familiar substitute is three 8-hour shifts. The cautious manufacturer is apt to conclude that this will increase the payroll by 50 per cent, and right here lies the greatest problem in eliminating the 12-hour shift. If the manufacturer wants to keep his costs the same, he naturally infers that he must keep labor costs where they are. In this case the wage earner will receive just two-thirds of his former daily wage. No such conclusion is warranted. In a very few instances, one a sulphuric acid plant, it has been found that the number of shift workers was increased just 50 per cent with no increase in production. Yet in another plant producing the same material the increased production attributed by the manager entirely to a reduction in working hours from 12 to 8 per shift was startlingly large.

It is therefore necessary to be very cautious about making dogmatic deductions with regard to this change. Each plant is an individual case. Few generalizations can be made even within a given industry. So much depends on the kind of equipment, the type of process,

the caliber of management, the attitude of the laborer, the progressiveness of the industry and the plant, the proportion of labor cost to total cost, etc.

Suppose we have a plant manufacturing a product where the labor cost is 25 per cent of the total cost. In most chemical industries this proportion is higher than actually exists, for the labor cost is often below 10 per cent and seldom above 20 per cent. If we increased labor cost 50 per cent, it would increase the cost of the product only 12 per cent. That, then, is a kind of limiting figure for changing from 12-hour to 8-hour shift. It assumes that the weekly wages would be kept exactly the same, the hourly rate would then be 50 per cent more and the total number of laborers increased by one whole shift.

SOME FACTORS WHICH WOULD DIMINISH THE THREE-SHIFT INCREMENT ON LABOR COST

In the first place, there are few works in which all the men would be on 12-hour shifts. Hence the increment would naturally be decreased in proportion to the number of men on shorter hours. Again it is a pretty safe generalization to claim that in a rearrangement of tasks which would accompany a fundamental change of this kind, a decided cut could be made in the number of workers per shift. In one plant I recall a large cut in the personnel of a shift by having each shift stay 9 hours and in that extra hour complete all the tasks incidental to actual operation. Therefore again the increment of cost necessary to effect a change from 12- to 8-hour shift would decrease, still maintaining the same weekly standard of wages.

In a sufficient number of cases to justify its inclusion the change from two shifts to three has focused the attention of the management on equipment and kindred problems, and a pronounced increase in plant efficiency has resulted. Perhaps the benefit cannot be solely attributed to the three-shift change, but its inception was undoubtedly due to the study made necessary by the three-shift change.

In many industries labor will do more work per hour in an 8-hour shift than in the longer session. This is, of course, much less true of the continuous process industries than of those in which a more skilled labor is necessary and a higher type of manual efficiency. Yet the sulphuric acid plant referred to above is only one example of many in which this result has been accomplished and there is no doubt that industrial accidents, absenteeism and labor turnover have all been favorably affected by the three-shift program.

Each of these points has been advanced to indicate the certainty that in changing from a two- to a three-shift program the labor costs would not be increased greatly even if the weekly earnings of the shift workers were kept to the figure obtained in 12-hour work. With slight reductions in total wages (but a higher hourly rate) and a slightly higher labor charge, the change can probably be effected in every industrial plant that is well managed.

The message which the report brings to the manufacturers is: "Don't shy at three-shift operation; investigate it. If it does cost more, you may be more than repaid by diminishing accidents, labor turnover and absenteeism. And it may not cost you anything." Furthermore, such a message is very timely when the immigration and emigration statistics are studied—a net loss in 1921 of 67,000 laborers (continuous process labor)! If that continues will it pay to diminish labor

turnover? It will not only pay, it will be absolutely essential.

OTHER SUBSTITUTES FOR THE 12-HOUR DAY

In addition to the three 8-hour shifts which have been discussed at such great length, there are other substitutes which have been used, as follows: (a) Cessation of work allowing two 10- or 11-hour days. (b) Nominal 12-hour day, but work completed in 10 to 11 hours. (c) Three overlapping 9-hour shifts. (d) Nine- and 10-hour shifts on a five-shift scheme.

This last alternative is so interesting that we have reproduced the diagram which is now used by Procter & Gamble for their shift labor. (See Fig. 1.) It is self-explanatory. You will note that there are always two shifts at work.

Some Further Conclusions Which Are Made in the Report

There are other conclusions which Mr. Drury finds closely related to those already discussed. He has found no technical difficulties in the way of changing from two- to three-shift operation. This is to be expected and could have been stated *a priori* by those who are acquainted with shift work. It was wise to include it in the report, however.

Mr. Drury found a general favoring of the three-shift plan and a negligible number of firms returning to a two-shift system after the three-shift plant had been tried. Another gratifying conclusion is that the daily wage earnings tend to equalize those of the two-shift system by an increase in the wage rate. You can argue at greater length than we did earlier in this report that wages won't have to be reduced, but an ounce or two of proof such as the above is worth much more.

Finally it is also gratifying to learn that the leisure time of the employee is well used. This is not necessarily to be expected from the type engaged in shift work, and many a manufacturer has remarked that the workers would drink away their spare time, advancing that as one reason why it would be foolish to change to three-shift work. It now becomes a boomerang and an added reason for adopting the shorter day.

WHAT IS MEANT BY CO-OPERATION OF THE WORKER

The summary concludes with a word of caution: Do not change without careful preparation. A sudden change not preplanned and which has not enlisted the co-operation of the workers is almost certain to result in lower production. And this is a word of great wisdom. It is a point which is worth enlarging, for those unfamiliar with operating work will completely miss the significance of the term "co-operation of the worker."

There was once a bright and ambitious chemical engineer who was assigned to the task of studying and revising a process. It was a batch process that required careful furnacing to an end point and subsequent leaching. If the end point was not reached, the material cooled to a hard, impenetrable mass. If it overburned, considerable destruction of product was involved. The chemical engineer wished to make some changes in operation which were logical and scientifically sound, but somehow or other they did not work. The yield did not improve. In fact it fell off. He was worried and went to the superintendent. The superintendent listened, waited a week spending an imperceptibly longer time in the department each day and assigning the

chemical engineer to other work. Then he spent an hour or more a day talking with the furnace men not about the work or the low yields (which the furnace men didn't know). Then one day they told him how they had fooled the chemical engineer. He had come in and changed the process so that it meant more coal to haul in and shovel. It was no cinch to stand up in front of that roaring blast and shovel in more coal. But they had fixed him, doctored the coal weights and run a hotter fire by building up from the start instead of burning gradually. So the particles were glazed and no additional action had been possible. It had not been a poor piece of technical work, but the "co-operation of the worker" had not been enlisted.

So the co-operation of the worker would have to be enlisted in this change to a three-shift plan. If it had been applied to the above process and the furnace men had been unsympathetic, you would have had every charge glazed or overburned. The reason would have been that the previous or the subsequent shift ruined the charges and "you can't get the furnace in shape on a short shift."

Mr. Drury struck a keynote when he mentioned the co-operation of the worker, and that is why earlier in this discussion so much emphasis was placed on not reducing the daily wages, for this is an important factor in labor co-operation. Even then there will be trouble in some organizations, especially where you have foreign elements. Their argument will be, "If you can pay the higher rate per hour, then we'll take it and work 12 hours too." They are horses for punishment! This subject of "labor co-operation" would be extremely appropriate for detailed investigation. It is the crux of success or failure in the two- to three-shift change.

TOO OPTIMISTIC CLAIMS MUST BE AVOIDED FOR THE SHORTER SHIFT

There is one other point of caution that must be urged. In many industries careful and thoughtful attention on the part of the management would increase process efficiency greatly. This careful and thoughtful attention is necessary when the change from two- to three-shift operation is made. Thus many improvements may be attributed to the change in working hours which are actually due to the study which accompanied it. We would be the last to desire in any way to put a damper on the splendid movement toward the elimination of the 12-hour shift, and we do not wish this to be interpreted in that light. Too often, however, a movement defeats itself by claiming too much and failing of accomplishment. We know organizations that still retain the 12-hour shift and which would not be benefited by the change to shorter shift. They have already been vigorous in their quest for labor efficiency. To try to sell them the 8-hour shift on the basis of marked improvement shown when other firms in the same industry adopted the shorter work day would be a mistake. No management engineer could produce the goods. Hence this word of caution that we should not attribute all the gains to the change in hours!

In an appendix to this discussion is given a summary of the 12-hour day problem in some of the industries in which the readers of *Chem. & Met.* are interested. There remains only a word of commendation and approval for the exhaustive and balanced report. The Federated American Engineering Societies is to be congratulated. The contribution to knowledge is signal. The direct gain to industry and to civilization should

be permanent and immense. The report will do more toward eliminating one of the black corners, fester spots, from our civilization than all the rant and chatter of the zealous reformers combined. It is distinguished evidence that the organization is fulfilling the worthy ideal expressed in its constitution: "To further public interest wherever technical knowledge and engineering experience are involved."

Appendix to the Report on the 12-Hour Day in American Industry

Herewith is a summary of the detailed studies made in industries in which *Chem. & Met.* readers are interested:

Glass—In the average glass factory, those men operating the furnace are involved in a continuous process work and there are probably more of them on 12-hour shifts than on 8-hour shifts, but there are relatively few men actually on furnace work. If the cutters and the annealers are also on continuous work, it brings the number up to a very considerable figure. On the other hand, in many phases of the glass industry, there has never been anything but relatively short hours. Bottle blowers, window-glass manufacturers and now even plate-glass manufacturers are all on a predominantly three-shift basis. Individual members of the organization, however, still retain the two-shift status.

Cement—Better and more inclusive data exist in the cement industry than in any other industry, due to the activities of the conservation committee of the Portland Cement Association. This committee has made a very interesting comparison between the man-hours required to produce one barrel of cement in those factories on two-shift operation and in those factories on three-shift operation. The table is important and is herewith reproduced. (Table I.) The difference is pronounced and the investigator was careful to inquire whether the more progressive concerns might have gone on three shifts, leaving the less progressive on two shifts, but the conservation committee of the association believed that the difference was not due to any extraneous conditions. The present view of the association, through the chairman of its conservation committee, seems to be that a combination of two-shift and three-shift operation is at the present a little more economical than the wholly three-shift operation, but it believes that ultimately the three-shift operation will be universal.

TABLE I—COMPARATIVE LABOR EFFICIENCY OF 86 PORTLAND CEMENT PLANTS IN 1920

Shift System	Number of Plants	Average of Group	Man-Hours to Produce One Barrel	
			Most Efficient Plant	Least Efficient Plant
Two-shift group.....	51	1.035	0.551	1.940
Three-shift group.....	22	.823	.466	1.540
Two-three-shift group.....	13	.756	.470	1.140

The hourly wage of the men as they went from two to three shifts was raised 6 or 7 cents an hour, so that they received slightly less than the 10-hour men, but only slightly less, and this increase in hourly wage has been more than wiped out by increased efficiency in the workers.

Lime—The lime industry has a smaller proportion of shift workers than the cement industry, with the result that the shift work is even less significant, only about 15 per cent of the men being involved. They are the ones that handle kilns, and in general they are on a two-shift basis, particularly in the East and the South. One plant is successfully running now on a three-shift basis, at the request of the workmen, and no increase in manning the kiln was necessary by a rearrangement of labor. Tables were given showing how this was worked out in practice.

Heavy Chemicals—There is relatively a small amount of two-shift operation in the production of heavy chemicals, and in the South this is principally on a 12-hour basis. In the North, except among smaller plants, the shift is 8 hours. In most cases the managers of heavy chemical plants express doubt as to any marked improvement in efficiency under three-shift operation. Most of them felt that there could be no increase in output, although they ad-

mitted it would have a favorable effect on accidents, inferior work, etc. The experience of one company, however, is exactly the reverse of this and production on a three-shift basis was increased markedly over the two-shift basis.

Fertilizers—In fertilizer plants the only department which has continuous work is the sulphuric acid department, and here in a plant having 100 laborers there would be only eight or nine on shift work. These are very largely on the 12-hour shift basis. It is the expressed opinion of a leader in acid production in the country that three-shift operation would be beneficial.

Explosives—Here again the number of men engaged in shift work is small and so far as is known, most of the work is carried out on a three-shift basis.

Dyes—Again, in this industry the processes are so varied that a generalization is somewhat unwise, but there are very few men on shift work and those that are on shift work usually work an average of 12 hours.

Industrial Alcohol—This commodity is manufactured in a number of plants. The largest company is entirely on a three-shift basis.

Soap—This is principally a daytime proposition in the majority of plants, except for a few men engaged in auxiliary processes. Ordinarily soap fats are boiled by day and permitted to settle by night. Some plants run on a two 12-hour shift basis when the market permits the plant to run at this capacity, but soap makers in general are against continuous operation except when it is essential.

Some companies, such as the Procter & Gamble Co., of Ivorydale, because they undertake more preliminary treatment of materials than is customary, have a larger percentage of men on shift operation. About 25 per cent of this company's employees are on continuous operation work.

Sugar—There are three branches of the sugar industry. (1) The sugar mills of the South which take Louisiana cane and manufacture white sugar from it. The majority of these mills are at the present time seasonal and work on two 12-hour shifts, with no thought of change.* (2) The refining of imported sugar by large refineries on the Atlantic, Pacific and Gulf seaboard. This type of factory employs no greater than 50 per cent of shift workers, although the whole process is practically continuous. Most of the refineries operate on two shifts, although some of the companies have tried out the three-shift operation with some success. Indeed, one of the plants of the American Sugar Refining Co. has been working for the last 4 years under a three-shift basis with excellent success. (3) Beet sugar. Here again we have a seasonal industry which does not last over 100 days and in which there is practically universal 12-hour shift work. It attracts many men year after year to this seasonal work, and in general they find it desirable. One company has, however, tried out the three-shift policy with satisfactory results, but it is the pioneer in this particular field.

Table Salt—This is an industry which requires very few men on shift work and with few exceptions the plants retain the 12-hour shift basis.

Petroleum—Together with rubber and some of the non-ferrous metals, this industry has the distinction of being solidly three-shift. The Standard Oil, and all of the important independents, are on the 8-hour system. With oil drilling, of course, the situation is different; contractors are in charge and govern their own crews and in addition the excitement of work in the field results in rush work and long hours.

Cottonseed, Linseed and Other Vegetable Oils—The crushing industry presents the largest 12-hour shift problem in American industries. The operation is seasonal, although in the larger companies it has been extended to 8 or 9 months, but the shortness of the season has demanded two-shift operation and the predominance of colored help may also influence the tendency toward two-shift operation. In refining very little work is done at night time and the crews engaged in this work are relatively small.

*EDITOR'S NOTE—It will be interesting to follow the effect of the use of vegetable chars on this industry. There are some of the plants now which operate continuously throughout the year and perhaps other arrangements than the 12-hour shift will come into vogue.

European Conditions as I Saw Them*

Status of the French Chemical and Metallurgical Industries,
Notably Dyes, Synthetic Nitrogen, Fuel for Internal Combustion
Engines, Iron and Steel—Hydro-Electric Power Development—
Impressions on the General Situation in Italy and Switzerland

BY J. S. NEGRU

BEFORE the war France had a flourishing heavy chemical industry, but was obliged to depend largely on Germany and partly on Switzerland for organic chemicals, especially dyes. The present status shows no material change. When the plants in the devastated regions shall have been fully reconstructed and put in operation, all of France's need for heavy chemicals can be met from home production, and she will even be in a position to export. With respect to the dye industry, she has made great efforts to become independent, but with no tangible success. Before the war there were in France four French dye plants, producing about 10 per cent of her requirements, although even these plants were obliged to import from Germany a large part of the necessary intermediates. In addition to these four, there were a few German-owned dye plants, but the combined production of all was not sufficient to meet domestic needs, and accordingly there was an annual import of about 2,000 tons of dyes, valued at about \$1,500,000. The total yearly consumption was about 9,000 tons, valued at about \$5,000,000.

FRENCH EFFORTS TO BUILD UP A DOMESTIC DYE INDUSTRY

Strenuous efforts were made during the war to build up a domestic French dye industry. It was in 1917 that the Compagnie Nationale des Matières Colorantes (National Dye Co.) was definitely established. Since then other companies have been formed, but all have had to struggle hard for existence and have been badly in need of government aid. This help has been given in some degree, but it has not been enough to insure the establishment of a self-supporting dye industry. The French have made mistakes in this industry, just as the other nations have. Primarily the construction program was far too ambitious. They put up plants of large size that could boast a capacity of 15,000 tons a year, but they found themselves without the necessary chemists, engineers, foremen and even common laborers to man them, not to speak of the difficulty of obtaining sufficient raw material to operate them. Of course this policy was wrong and bound to meet with failure. The experience has been a hard teacher, but the lesson has been learned, and in July I discovered that the industry was making a fresh start in the direction of educating and recruiting trained personnel with which to man the plants.

FRENCH DYE INDUSTRY TO GET GERMAN TECHNICAL ASSISTANCE

In connection with the French dye industry, our readers will recall that when Dr. Hendrick returned from his summer in England he wrote a review of the dye situation in Great Britain and Europe as he had

observed it. Particular emphasis was laid upon the Franco-German working agreement whereby the German firms were to give the French company technical assistance and information regarding the processes of manufacture and to supply German chemists to supervise work in the French dye plants. In return the French company was to limit its field of commercial activity and allow the Germans a share of the profits. I was in Belgium when news of this arrangement was published in the *London Times* for Aug. 1, and I immediately took occasion to discuss the proposal with all who might be expected to have an opinion on it. The general reaction to this prospect of Germany becoming an international partner in the dye industry of various countries was distinctly favorable; and however surprising and distasteful this view may be to Americans, I am sure that as far as Europe is concerned it has much to recommend it. The nations of the world are all desirous of establishing their own dye industries, having been impelled to take this step as a matter of national defense, if not of industrial advantage. Germany, on the other hand, has 50 years of knowledge and experience in dye manufacture. It is well recognized that this knowledge and experience are of more value than all the plants that European countries can erect at the present time, if they find themselves unable to operate them efficiently. Why, then, it is not good business for France or any other country to enter into an agreement with Germany whereby the latter will furnish the necessary knowledge, experience and supervision of manufacture in return for a share of the profits? France can thus at one stroke obtain the benefit of 50 years of experience; can begin immediately the establishment of a domestic dye industry; can train her own chemists and technicians in the necessary technique of the business, and ultimately develop at home a dye industry quite as efficient and serviceable as exists in Germany itself.

ADVANTAGES OF FRANCO-GERMAN DYE INDUSTRY AGREEMENT

Much has been made of the necessity for establishing a dye industry in countries other than Germany on account of the close relation of this business to chemical warfare. The industry is rightly recognized as a factor in national defense, although I feel that Germany's erstwhile advantage in this respect has now largely disappeared. And with the continued infiltration of German dye chemists into France and other countries and the gradual building up of a domestic industry and trained personnel, the German advantage is bound to diminish to a point where it will disappear altogether. No one knows better than the Germans that their original advantage lay in their knowledge and experience, more than in their plants; and accordingly it is they who recognize the waning of this advantage as the other nations develop experienced men.

*This is the sixth of a series of articles by Mr. Negru on this subject. The preceding articles appeared in the issues of Oct. 18, Oct. 25, Nov. 8, Nov. 15 and Nov. 22.
Chem. & Met., Nov. 29, 1922.

Regardless of how others may look at the problem, the French see clearly the advantage of using their present plants as practical schools under German tutorship, knowing that otherwise the industry will become more and more of a liability. This is a beginning in the international diffusion of knowledge that in my judgment will do more than solemn peace agreements to abolish chemical warfare, by putting the nations of the world on an equal footing with respect to it. This view is prevalent even among some thoughtful heads in Germany who know that it is not plants, but chemists, that really count. Plants can be erected quickly enough, but chemists cannot be made to order, at least not on short order.

SYNTHETIC NITROGEN INDUSTRY

The synthetic nitrogen industry is absorbing the attention of the French to a degree even greater than that of her dye industry. This results from the ever-increasing need of ammonia fertilizers. Thus the French consumption of ammonium sulphate was only 127,000 tons in 1921, when more than 300,000 tons is needed. Warm debates and discussions are held as to whether France shall adopt the Haber-Bosch process in her prospective plants or whether she shall wait until Claude has solved all the problems of commercial production by his high-pressure process. The cyanamid process also has its advocates, and even the arc process is considered. The question is so important that the French Society of Civil Engineers devoted two meetings to a discussion of the problem. The four processes were presented by experts, and later the relative merits of each were discussed by chemists and engineers in the hope of reaching a well-considered decision. Messrs. Gros, Patart, Claude and Garaix presented respectively the arc, Haber-Bosch, Claude and cyanamid processes. The weight of opinion is in favor of the second and third, although no final conclusion has been reached.¹⁷

FUEL FOR INTERNAL COMBUSTION ENGINES

One of the most important problems now confronting France is the development of a new fuel for internal combustion engines. It is known that she possesses very small petroleum fields and that practically her entire requirements of gasoline have to be imported. On the other hand, France is a large producer of alcohol and a great deal of experimenting has been done to use at least a part of this material as fuel. The first practical attempts were not very encouraging, and it seemed that something would have to be done to encourage further experimenting. With this in view the Agricultural Committee of Béziers instituted a national competition, offering prizes for the best practical solution of the problem. The main requisite is that the fuel shall contain at least 10 per cent alcohol. The result of this competition was made public on April 9, 1922, and revealed more than 100 formulas which were submitted to a specially instituted committee for exhaustive study.

The principal difficulty to be overcome in producing a suitable fuel is to bring about a homogeneous mixture of commercial alcohol and gasoline. The methods presented were classified into two general groups. In the first, a third liquid is added to act as a solvent for the mixture of commercial alcohol and gasoline, the main solvents suggested being butyl alcohol, cyclohexanol, non-caustic derivatives of cresols and isopropyl alcohol. In

the second, methods were proposed for dehydrating commercial alcohol and thus making possible the comparatively easy mixture of absolute alcohol and gasoline.

Other suggestions involved the mixture of light oils and commercial alcohol, while still others proposed the use of fractions from the distillation of wood tar. Finally, another group of suggestions proposes the use of an easily obtained admixture of alcohol and an ether derived from alcohol.¹⁸

IRON AND STEEL

The iron and steel industry of France is one of great potentiality. She is now a leading producer of iron ore, and the market for this ore as well as for the finished product is most encouraging. For years to come she will have as her own best customer her war-devastated industries.

There is much talk in France and in Belgium about the policy of the French Government in raising an almost prohibitive tariff against the importation of finished products of iron and steel. Belgium especially resents this, as she is suffering quite as much from the French policy as she did from German competition. Another even stronger complaint of the Belgian metallurgist is that although the French compete effectively for export business, they prevent the importation of iron and steel even when Belgian bids are lower than their own. This leads to the conclusion that French metallurgical companies are getting for their products in their home market prices above those asked by the Belgians.¹⁹

DEVELOPMENT OF HYDRO-ELECTRIC POWER

The development of French hydro-electric power is very encouraging. A little over 2,000,000 hp. is now being developed, and new plants are constantly being built. In this connection the activities of the Electrochemical and Electrometallurgical Institute at the University of Grenoble have been of the greatest service, because through it France is enriched every year with a number of engineers particularly familiar with hydro-electric development. In addition to this, the magazine *La Houille Blanche*, devoted entirely to water power, is keeping the French engineers informed of progress in this important industry.

The electrification of the greater part of the French railways is seriously studied, but no definite plans have been announced. I was impressed with the great field for this development when I observed coal-fired inter-urban tramways within walking distance of the Romanche River in the Grenoble district with its many hydro-electric plants.

FRANCE AS AN INDUSTRIAL COUNTRY

The potentiality of France as a great industrial country is conspicuous to an engineer traveling from border to border. It will be necessary for her to import fuel for many years to come, but the steady development of her water-power resources will enable her gradually to overcome this handicap. Her colonies will supply her with many of the raw materials which she is now lacking, and to a certain extent even with common labor. With respect to the latter, however, I learned that France is now making tempting offers in her western

¹⁷A detailed description of the effort to develop a national liquid fuel for France (Combustion National) will form the subject of a separate article in this magazine.

¹⁸A summary of the proceedings of these meetings will form the subject a separate article in this journal.

¹⁹The *Exportateur Belge* of July 9 cites the case of Belgian rails being offered in France at about 20 francs per ton less than the price asked by the French, and yet the Belgians did not get the order.

industrial districts for immigrants from Italy, Poland, Spain and other eastern and southeastern European countries.

France still has many difficulties to overcome, the principal one being her fear of German aggression, against which she feels the need of assurance. In consequence of this fear she is now in the full grip of a military preparedness policy that imposes upon her economic system a heavy burden in military expenditures, in addition to depriving her of the productive work of many hundreds of thousands of young Frenchmen.

TRIP THROUGH ITALY AND SWITZERLAND

My trip through Italy and Switzerland was only of short duration and I did not have an opportunity to corroborate my first impressions by a subsequent trip. It must suffice, therefore, for me to say that both these countries are suffering from unemployment and that their economic ills are the consequence of the fact that Italian money is badly depreciated, while Swiss money is still worth its face value.

In Italy the domestic industries are suffering because, in the absence of domestic fuel and raw material, they are limited in their ability to import by the low exchange value of the lira. Apparently it is much cheaper to import finished German goods, especially in view of the German industrial policy of exporting at ridiculously low prices. I was told that practically all of the money received in payment for these imported

products is invested by the German industrials in Italian industries, and that this policy is assuming alarming proportions.

In Switzerland, with her money at pre-war value, it is practically impossible for domestic industries to compete with those of any other European country. Accordingly, Germany is very active in supplying Switzerland with finished products, especially in view of the fact that they are paid for with Swiss francs, which are then placed to the account of the exporters in Swiss banks. Pre-war revenues from tourists, which formerly assumed large proportions, are now practically non-existent, due to the high cost of living. Switzerland is, therefore, among the least favored of the European countries from an economic point of view. As already shown in a previous article, Swiss manufacturers are reduced practically to the rôle of middlemen for German manufactured goods—a very pathetic situation.

Both Swiss and Italian banks, I was told, are enjoying a large and profitable business due to the abnormal conditions in international exchange, and the large volume of German commercial transactions.

At Geneva I had an opportunity to investigate the objects and workings of the International Bureau of Labor. This will form the subject of a separate article on this important adjunct of the League of Nations.

Other articles on this subject by Mr. Negru will appear in subsequent issues.

Weighing CO₂

IT HAS been recognized that excess air is the enemy to economy of boiler operation, and it is no longer unusual to see the engineer hunting for air leaks on the outside of the furnace with a smoky candle. Perhaps the one source of excess air which is most damaging and at the same time the most difficult to detect is a hole through the bed of fuel—in other words, what the fireman knows as a "hole in the fire." This, of course, may be caused in various ways. The fire may burn out faster at one point than at another, the fuel bed may not have been placed on the grate evenly, etc. In the case of hand fires, one of the principal duties of the fireman is to watch for such holes in the fire as they admit excess air, which, passing up the chimney, carries with it valuable heat.

Holes in the fire are difficult to detect in the case of some mechanical stokers, especially where boilers are placed close together in battery or there is a forced draft arrangement boxing in the grates. To detect holes in the fire should be one of the principal functions of the CO₂ apparatus, and to do this the apparatus should be of such a nature and location as to communicate the message to the fireman promptly. In other words, as a steam gage indicating the boiler pressure located in the chief engineer's office would be very little help to the fireman, so also the CO₂ apparatus placed too far away from the firing floor is of little use to him.

There is another difficulty with some CO₂ apparatus as it exists today, and that is that the scheme depends on the dissolving of the CO₂ gas in potassium hydrate solution. This means that the apparatus is, in a sense of the word, a small chemical laboratory. It is slow in operation, expensive, more or less troublesome to maintain, so placed as to be of little use to the man on the firing floor and, above all, necessarily operating in such a way as to deliver its message some little time

after the condition took place in the furnace. So far as the CO₂ apparatus is concerned, the fireman is still going it blind as a general thing.

Some months ago Dr. Zacharius Olsson, who has had considerable experience in power house work, had his attention called to the inadequacy of the present method of following excess air and CO₂ from the standpoint of the man on the firing floor. Appreciating how valuable it would be to the fireman to have some sort of an indicator that could be placed on the front of the boiler exactly as the steam gage is placed and which would require no more attention than does the steam gage, Dr. Olsson conceived the idea of building a CO₂ apparatus which would weigh the gases as they pass through and indicate differences in CO₂ percentage by gravity rather than to use the principle of dissolving them in solution with all the attendant evils of the small laboratory. There would be no solutions, no glass containers, no laboratory—simply a weighing machine reduced to its lowest terms and of the simplest possible nature.

The writer remembers a visit to Dr. Olsson's laboratory at Staten Island where he saw this gravity CO₂ apparatus attached to a small heater. It was interesting to note how the doctor could make the pointer go down from 14 per cent to zero in 3 or 4 seconds by opening the fire door, bringing it back to maximum again almost instantaneously by reversing the process. This might be called remarkable considering the lag of the ordinary apparatus due to the necessity of dissolving and measuring the sample of gas.

No large modern boiler plant is now considered efficient or complete unless it has been provided with steam flow meters, automatic feed regulators, draft control, soot blowers, feed water treatment and control, pyrometers and, not least of all, CO₂ apparatus. Dr. Olsson's CO₂ indicator will go a long way toward bringing this particular instrument into the easy range of vision of the man handling the shovel.

Decarburizing Ferrochromium by Hydrogen

BY LOUIS JORDAN AND F. E. SWINDELLS
Chemist and Assistant Chemist Bureau of Standards

RUSTLESS IRON

CONSIDERABLE publicity has recently been given to the development in England of a rustless or stainless iron and the uses to which such material may be put. Stainless steel has become a familiar class of material. It contains in the neighborhood of 13 to 16 per cent chromium and usually 0.3 to 0.4 per cent carbon. Rustless iron contains about the same proportions of chromium, but its carbon content is lower, in the neighborhood of or less than 0.1 per cent.

Some of the advantages claimed for rustless iron¹ over stainless steel are that it is more ductile, more easily rolled or forged, does not require special heat-treatment of the ingots before working, and machines more readily. It is said to have stainless or rustless properties close to those of stainless steel. It is also stated that marine growths will not adhere to plates rolled from rustless iron.

NEED FOR LOW-CARBON FERROCHROMIUM

Commercial ferrochromium contains 60 per cent chromium and 4 to 8 per cent carbon. In order to produce an iron alloy containing not over 0.1 per cent carbon and as high as 12 per cent chromium it is evident that such alloy cannot be used. In order to produce a 12 per cent chromium alloy with not over 0.1 per cent carbon a 60 per cent ferro should contain not more than 0.5 per cent carbon.

"Carbon-free" metallic chromium and ferrochromium is manufactured by aluminothermic reduction methods. These materials, however, command 40 to 60 cents per pound of contained chromium, as against about 11 cents for the ferro containing 4 to 6 per cent carbon. Chromium in 100 lb. of rustless iron would cost from \$4.80 to \$7.20 when added as carbon-free aluminothermic alloys. Rustless iron would thus be too seriously handicapped in commercial uses compared with ingot iron, copper-bearing steel, or many non-ferrous metals.

It is reported that an English process for low-carbon ferrochromium enables a selling price of 20 cents per pound for ferro containing only 0.25 per cent carbon.²

REFINING HIGH-CARBON FERROCHROMIUM

Recent patents have described the production of low-carbon ferrochromium by subjecting crude, high-carbon ferro to an oxidizing blast in a converter;³ to electric furnace treatment with oxides of iron or chromium,⁴ or of titanium,⁵ or by blowing molten high-carbon ferrochromium in a converter with the injection into the blast of steam, or some other gas or vapor.⁶ Ballantine has also patented⁷ the method of reduction of chromium oxides with calcium carbide in the presence of an alkaline earth oxide with or without calcium silicide

or aluminum. A still more recent patent⁸ claims the method of producing rustless steel containing low carbon by adding a mixture of aluminum and chromium ore to a molten decarburized steel in an electric furnace.

DECARBURIZATION BY HYDROGEN

The use of hydrogen for the removal of carbon from iron and iron alloys has previously been suggested and demonstrated experimentally. Schmitz⁹ showed that heating cast iron in hydrogen at 1,200 deg. C. for $\frac{1}{2}$ hr. reduced the carbon from 3.46 per cent to 2.74; by further successive heatings of 2 to 3 hours each the carbon was reduced to 2.16, 1.38, 0.53, and finally to 0.03 per cent. Plain carbon steels were appreciably decarburized in 15 to 35 minutes at 1,200 deg. C. A 25 per cent nickel steel containing 0.99 per cent carbon was treated three successive times for 2 hours each. The carbon dropped to 0.61, 0.11 and 0.08 in the successive heatings. Schmitz also heated 0.05 gram of "kish" for 15 hours at 1,100 deg. C. in hydrogen; it lost 63 per cent of its weight. A 0.2-gram sample of graphite heated 3 hours at 1,000 deg. C. in hydrogen lost 8.7 per cent of its weight.

Campbell¹⁰ decarburized several steels by heating in moist hydrogen at 950 to 1,000 deg. C. for 4 to 12 days. Chromium-molybdenum steel of an original carbon content of 1.67 per cent was reduced to 0.22 per cent after 12 days at 950 to 1,050 deg. C. Campbell concludes from results on plain carbon and alloy steels that pure carbides of iron are less stable when in solid solution than are the carbides which are formed if some other elements are present—e.g., manganese.

Austin¹¹ has recently described the surface decarburization of three carbon steels treated in both moist and dry hydrogen at several temperatures between 400 and 1,000 deg. C.

Ferrochromium used in the present tests was a commercial grade crushed to pass 80 mesh. This fine material contained 56.6 per cent chromium and 8.47 per cent carbon. The results of all tests are summarized in Table I.

ACTION OF HYDROGEN ON SOLID FERROCHROMIUM

Twenty grams of the material was placed in a silica boat and heated within a silica tube at 900 deg. C. in a nichrome-wound electric combustion furnace. Temperatures in all runs in tube furnaces were controlled by the power consumption of the furnace, a calibration having previously been made with the thermocouple placed in the usual position of the boat. Hydrogen gas used was commercial compressed hydrogen purified by passing successively through tubes containing soda lime, platinized silica at a red heat, concentrated sulphuric acid and phosphorus pentoxide. Carbon dioxide, oxygen and moisture should be removed by this purification.

In the first trial the pure dry hydrogen was passed over the sample of ferrochromium for 1 hour after the furnace tube reached the desired temperature. The rate of passage of hydrogen was 4 $\frac{1}{2}$ liters per hour. Three-quarters of an hour was required for the boat to reach 900 deg. C. The sample was cooled in the stream of hydrogen. Analysis of the treated sample showed no loss in carbon. (Table I.)

¹Published by permission of the Director of the Bureau of Standards of the U. S. Department of Commerce.

²L. Aitchison, *Foundry Trade Jour.*, vol. 24, p. 418 (1921), also pp. 413 and 435, *Chem. & Met.*, Oct. 12, 1921, p. 717; Dec. 14, 1921, p. 1108.

³*Iron Age*, vol. 109, p. 597 (1922).

⁴W. B. Ballantine, U. S. Pat. 1,386,981; Brit. Pat. 159,568; *Chem. Abs.*, vol. 15, p. 2060.

⁵A. W. Clement, U. S. Pat. 1,365,091; *Chem. Abs.*, vol. 15, p. 824.

⁶H. C. Sicard, U. S. Pat. 1,341,939; *Chem. Abs.*, vol. 14, p. 2141.

⁷Krupp Akt.-Ges., Brit. Pat. 148,456; *Chem. Abs.*, vol. 15, p. 230.

⁸W. B. Ballantine, Brit. Pat. 152,399; *Chem. Abs.*, vol. 15, p. 667.

⁹W. B. Hamilton and T. A. Evans, Brit. Pat. 174,271; *Chem. Abs.*, vol. 16, p. 1737.

¹⁰F. Schmitz, *Stahl und Eisen*, vol. 39, p. 373 (1919).

¹¹E. D. Campbell, *J. Iron and Steel Inst.*, vol. 100, p. 407 (1921).

¹²C. R. Austin, *J. Iron and Steel Inst.* (advance proof), May, 1922; *Chem. & Met.*, Sept. 6, 1922, p. 510.

TABLE I—DECARBURIZATION OF FERROCHROMIUM BY HEATING IN HYDROGEN

Run No.	Duration of Run; At Max. Temp.		Approx. Temp. Fe-Cr., Deg. C.	Carbon in Original Fe-Cr, Per Cent	Carbon in Fe-Cr After Treatment, Per Cent	Reduction in Per Cent Carbon in Fe-Cr	Remarks
	Hr.	Min.					
1	1	0	900	8.47	8.57		
2	1	30	1,000	8.47	8.14	0.33	Fe-Cr, noticeably oxidized after treatment. Moist hydrogen used.
3	3	30	1,000	8.47	8.14	.33	Fe-Cr, oxidized. Moist hydrogen used.
4a	4	15	1,100	8.47	8.16	.31	Fe-Cr, bright, indicating no oxidation.
4b	2	45	1,100	8.16	8.14	.02	Residue from Run 4a reheated.
4c	4	15	1,100	8.14	7.88	.26	Residue from Run 4b reheated.
7	4	0	1,350	8.41	6.54	1.87	Unfused portion.
8	4	0	1,350	8.41	5.21	3.20	Fused portion.
9	..	4	1,500-1,600	8.47	6.80	1.61	Unfused portion.
10	..	20	1,600-1,700	8.47	6.23	2.18	Fused portion.
					7.50	0.97	Hydrogen bubbled through molten Fe-Cr.
					6.91	1.56	Hydrogen blown on surface of molten Fe-Cr.

The conditions in run 2 were modified to conform more nearly to those used by Campbell¹⁰ in the decarburization of steels. The hydrogen, free from oxygen, was bubbled through water at room temperature before passing into the furnace. The temperature of the furnace was raised to 1,000 deg. C. The heating period: 1 hour to reach 1,000 deg. C. and 1½ hours at full temperature. The carbon in the sample after treatment was 8.14 per cent, a drop of 0.33. A longer test, other conditions being repeated, gave no greater loss in carbon. In both runs, the ferrochromium was noticeably oxidized. Carbon may have been lost due to oxidation by moisture rather than reduction by hydrogen.

Consequently, in trials 4a to 4c the hydrogen entered the furnace dry. At the same time the temperature was increased to 1,100 deg. C. Tests 4b and 4c (Table I) represent a second treatment of the ferro-alloy used in 4a and 4b, a small sample for carbon determination being removed between heatings. For runs 4a to 4c the total time of heating was 11½ hours, but the total loss in carbon was only 0.57 per cent. After treatment the ferro was bright and not oxidized.

It thus appears that somewhere between 900 and 1,100 deg. C. the reduction of carbon by dry hydrogen became appreciable, although the reaction was slow at the upper temperature. The next tests were made with a still further increase of temperature.

A platinum-wound tube furnace was used in runs 7 and 8. A porcelain tube was used to contain the boat and sample, and in experiment 7 the boat also was of porcelain. The furnace was operated at 1,350 deg. C. and the hydrogen was thoroughly dried as before. When the boat was removed (after 4 hours' heating) it was found that the ferro-alloy in one end had melted, while in the other end it was slightly sintered. Analysis showed a loss of 1.87 per cent carbon in the unfused portion and 3.20 per cent in the fused portion. There were indications of some attack of the glaze of the porcelain boat by the molten ferrochromium, and the greater loss of carbon in the fused portion might have been caused by reaction with this glaze.

In the next trial all conditions were identical with the exception that an alundum boat was used. After heating, the sample was found to have been partly melted as in run 7. The loss of carbon was 1.61 per cent in the unfused portion and 2.18 in the fused.

The two tests at 1,350 deg. C. pointed to the conclusion that there is a sudden and marked change in the rate of decarburization at the melting point of the ferro-alloy. The Krupp patent¹¹ seems to cover the use of any gas or vapor in the blast of the bessemer converter. The above tests would indicate that hydrogen might be used effectively in such a manner.

ACTION OF HYDROGEN ON MOLTEN FERROCHROMIUM

To obtain some indication of the effectiveness of blowing molten ferrochromium with hydrogen, two tests (Nos. 9 and 10) were made in which the ferro-alloy was melted in a high-frequency induction furnace. The alloy in experiment 9 was melted in a magnesia crucible under a stream of hydrogen and then held somewhat above 1,500 deg. C. and dry hydrogen bubbled through the melt for 4 minutes by means of a fused silica tube leading to the bottom of the crucible. This silica tube was corroded slightly. Carbon was reduced from 8.47 to 7.50. That this loss in carbon was not due to oxidation by silica from the small tube was indicated by the fact that the silicon in the original ferro-alloy was 0.87 per cent, while after run 9 it was 0.55 per cent. The efficacy of blowing molten ferrochromium with hydrogen is striking when compared with the reduction of 1.87 per cent in the unfused alloy after heating for 4 hours at approximately 1,350 deg. C.

Molten metal heated by direct induction is very rapidly stirred by the magnetic flux. It was thought worth the trial to make a test in which hydrogen was blown only on the surface of molten and rapidly stirred ferrochromium. For run 10 the alloy was melted in a crucible made of 85 per cent magnesia and 15 per cent zirconium silicate. The molten metal was unintentionally permitted to attain a temperature of 1,700 deg. C., a much higher temperature than in run 9, and the silica tube through which the hydrogen was flowing was rapidly melted off at the end, although not touching the molten metal. Hydrogen was blown on the surface of the melt for 20 minutes.

The carbon content of the alloy in this run was reduced from the original 8.47 to 6.91, a loss of 1.56 per cent. This loss in carbon was caused in large part by the reduction of silica at this high temperature, as is indicated by the increase of the silicon content of the ferrochromium from the original 0.87 to 1.61 per cent.

SUMMARY

These preliminary tests indicate that while the decarburization of ferrochromium by means of hydrogen takes place to some extent at temperatures below the melting point of the alloy, the most promising condition for refining high-carbon alloy by this method is probably by blowing the molten alloy with a blast of hydrogen in a converter.

Metal Corrosion Report

"Corrosion of Metals and Materials by Acids and Alkalis" is a report by Maurice Siegel, who has made an elaborate study for the Chemical Division of the Chemical Warfare Service. The report is made up of an extended discussion of the theoretical considerations and practical methods of measuring corrosion, supplemented by a full bibliography and a tabular summary of many hundred experimental results which have been calculated to a common basis of presentation. It may be obtained from the Chief of Chemical Warfare Service, Washington.

Evaporation—A Study of the Various Operating Cycles In Triple Effect Units

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A General Method of Discovering the Best Operating Cycle for Triple Effect Evaporators Described—"Heat Balance" Worked Out for a Sample Case and the Type of Conclusions Which Can Be Reached Is Indicated

WE WERE TAUGHT in the old textbooks, and are still taught in some of the new ones, that in a multiple-effect evaporator, for each pound of steam supplied to the equipment, we obtain '1 lb. of evaporation in each vessel. This is not exactly true under any condition, and far from being true under average operating conditions. It was originally based on the assumption that for all pressures existing in the various bodies the latent heat of steam, L , was constant and to all intents and purposes 1,000 B.t.u. per pound. That this assumption is not justified is shown by the curve in Fig. 1, which shows the varying values of this latent heat within the range of temperatures commonly encountered in evaporator practice.

Another error which is quite prevalent is the fact that the liquid fed to the evaporator passes usually through the various bodies in series, from the high-temperature end to the low-temperature end, and as it goes from a hot to a cooler body a "flash," or self-evaporation, takes place, bringing the feed down to the temperature of the body into which it is entering. When this evaporation is taken into account, it has a very material effect on the balances of heat flow, depending upon the weight per unit of time and the range of temperature fall.

TEMPERATURE OF FEED LIQUOR MOST IMPORTANT

By far the largest variable in estimating the amount of evaporation per pound of steam is the temperature of the liquid as it enters the multiple effect, as compared with the existing boiling temperature in the first body. Obviously if the liquid must be heated to the boiling temperature, steam must be used up which would otherwise be available for evaporation. On the other hand, if the liquid temperature is higher than that in the first body, a "flash" takes place and actually more than a pound of water will be evaporated per pound of steam. The same condition exists as a rule in the subsequent bodies of a multiple, since there is always a "flash," and the evaporation will be greater than the amount of vapor condensed on the steam side. Therefore, in making calculations of the evaporation possible in a given effect it is a matter of balancing the latent heat available from the condensation of steam in the calandria against the latent heat represented by evaporation on the liquor side, to which must be added the heat required to bring the liquor to a boil if it is too cold, or from which must be subtracted the heat represented by "flash" if it is too hot.

THE USE AND CALCULATION OF HEAT BALANCES

The only way to determine accurately the operation of an evaporator is by making a thorough study of the heat transferred, with the aid of a heat and liquor flow sheet, or heat balance, in which all the steps and their interrelations are shown. When conditions are known, it is not difficult, and this method of analysis permits us to acquire a comprehensive grasp of relatively com-

plicated evaporator problems. We shall illustrate by submitting an analysis of what to our mind is one of the most interesting problems in evaporation—namely, the determination of the most advisable cycle of feed, governed by the consideration of steam economy alone.

Let us assume that we have a triple effect, whose bodies are numbered 1, 2, 3, beginning at the steam end and finishing at the condenser end. The question we wish to discuss is this:

All conditions being precisely the same, with the exception of the temperature of the liquid entering, which is variable, is it advantageous that the feed shall go through the three bodies in series, 1, 2, 3, commonly known as "parallel current," or 3, 2, 1, "counter-current," or shall each body be fed independently?

There are many conditions aside from heat economy which preclude the possibility of using some of these cycles, but we shall in this case assume that heat economy is the only determining factor.

In order to avoid unnecessary complications which would cloud the issue, we will arbitrarily assume the following conditions, which are not perhaps what we would find in practice, but which will serve well enough for this discussion, which we do not wish to complicate by the introduction of some forty-odd variables entering in evaporator work:

Liquid to be treated per hour.....	100,000 lb.
Evaporation required	70,000 lb.
Evaporation in triple effect.....	
Initial feed temperature.....	Unknown and variable
Specific heat of solution.....	Unity
Viscosity	Negligible
Boiling temperature rise	Negligible
	St. Belt St. Belt St. Belt Vapor Belt
	1 2 3 3
Press and vac.	5.0 lb. 2 in vac. 14 in vac. 26 in vac.
Temperature	227 deg. 209 deg. 182 deg. 125 deg.
Latent heat	960.7 B.t.u. 972.2 B.t.u. 988.7 B.t.u. 1021.6 B.t.u.

Complete heat balances have been calculated for "parallel current" operation, also for "counter-current" and "parallel feed" for initial feed temperatures of 50, 100, 150, 200 and 250 deg. It would take up too much space to give them all completely here. We have therefore made abstracts for each cycle, giving the information required to compare performances. We shall detail for illustration one of these heat balances for each cycle, calculated for a feed temperature of 150 deg., as representing probable average conditions encountered in practice.

CALCULATION OF "PARALLEL CURRENT" HEAT BALANCE

In the calculation given in Table I, we begin by admitting into the steam belt of the first effect 27,800 lb.¹ of steam per hour at a pressure of 5 lb. gage, corresponding to a temperature of 227, which upon condensation gives up its latent heat 960.7 B.t.u. per pound, making a total of 26,700,000 B.t.u. liberated.

¹This figure is reached by a process of trial and error which necessitated calculating the complete heat balance after assuming this initial figure. Three or four calculations are usually sufficient to arrive at a figure which will check out within operating limits of accuracy.

TABLE I—PARALLEL CURRENT HEAT BALANCE
Feed Temperature = 150 deg. F.

Specifications:	Heat	Liquor
(1) Steam, 27,800 lb. @ 5 lb. = $27,800 \times 960.7 =$	26,700,000	100,000
Deduct for heating $100,000 \times (209 - 150 = 59) =$	5,900,000	
Available for evaporation.....	20,800,000	
$L @ 209 = 972.2$ $E_1 = \frac{20,800,000}{972.2} =$		21,400
(2) Vapor ex. 1.....	20,800,000	78,600
Add flash, $78,600 \times (209 - 182 = 27) =$	2,120,000	
Available for evaporation.....	22,920,000	
$L @ 182 = 988.7$ $E_2 = \frac{22,920,000}{988.7} =$		23,200
(3) Vapor ex. 2.....	22,920,000	55,400
Add flash, $55,400 \times (182 - 125 = 57) =$	3,160,000	
Available for evaporation.....	26,080,000	
$L @ 125 = 1,021.6$ $E_3 = \frac{26,080,000}{1,021.6} =$		25,500
Excess		29,900

This is transmitted to the liquor through the heating surface, part of it being used to bring the feed temperature to the boiling point, in this case, 209. The initial temperature being 150, the necessary rise is $209 - 150$, or 59. Inasmuch as the entire feed enters the first body, we must heat it all, 100,000 lb., through this rise of 59 deg., thus absorbing 5,900,000 B.t.u. The heat left available for evaporation is therefore $26,700,000 - 5,900,000$, or 20,800,000 B.t.u. The latent heat at the temperature of ebullition, 209 in the first effect, is 972.2 B.t.u. per pound. The evaporation in the first effect will therefore be 20,800,000 divided by 972.2, or 21,400 lb., and the amount of feed transferred from the first to the second effect will be the amount of the original feed, 100,000 lb., less this evaporation, 21,400, or 78,600.

For the second effect, we obtain heat from two sources: First, the vapor from the first effect, which upon condensation gives up its latent heat, shown above

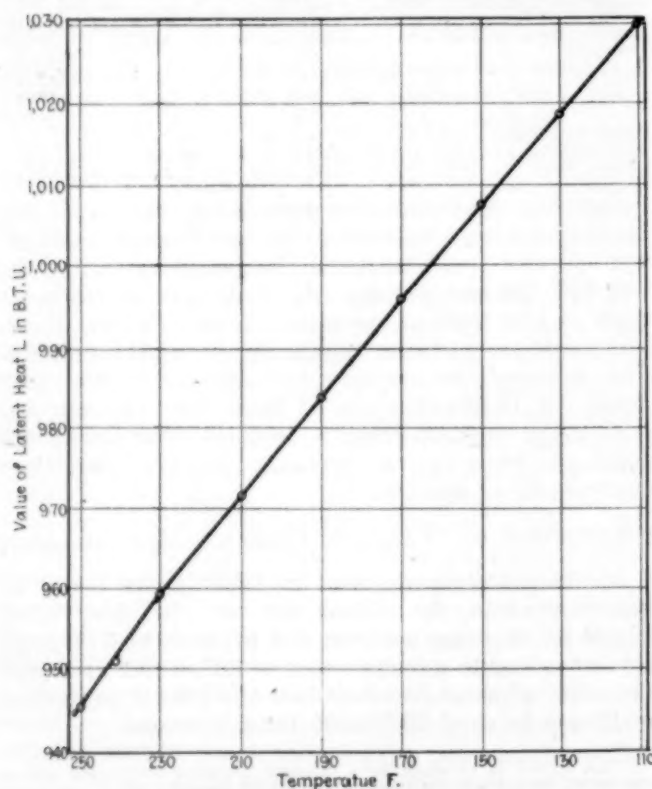


FIG. 1—VARIATION OF LATENT HEAT WITH TEMPERATURE

to be 20,800,000 B.t.u.; and second, the heat obtained from the flash or self-evaporation taking place when the feed leaves the first body at a temperature of 209 and enters the second at 182, thus giving up 27 B.t.u. per pound. The amount of this liquor being 78,600, as shown above, the total heat liberated in this way will be 78,600 times 27, or 2,120,000 B.t.u., making a total of 22,920,000 available for evaporation in the second body. The latent heat at this point at the existing temperature of 182 is 988.7 B.t.u. per pound, and the corresponding evaporation will be 22,920,000 divided by 988.7, or 23,200, and the liquor transferred from the second to the third effect will be the amount which entered this body, 78,600, less this evaporation, 23,200, or 55,400 lb. per hour.

A similar exchange takes place in the third effect. First the vapor from the second body condenses, giving up its latent heat, shown above to be 22,920,000 B.t.u., and the feed from the second flashes down from its original temperature of 182 to that of the third effect, 125, thus giving up 57 B.t.u. per pound. The quantity being 55,400 lb., the heat thus liberated is 3,160,000 B.t.u., which when added to the above gives us a total

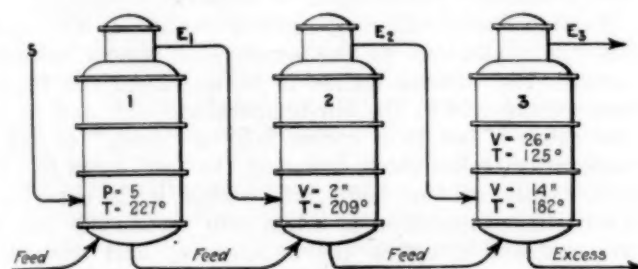


FIG. 2—DIAGRAMMATIC SKETCH OF PARALLEL CURRENT OPERATION

of 26,080,000 available for evaporation in the third effect. The latent heat of steam at the third body temperature, 125, is 1,021.6 B.t.u. per pound, and the evaporation here is therefore 25,500 lb. per hour, which when deducted from the feed into the third effect, 55,400 lb., leaves 29,900 lb. which is removed from the last body as concentrated liquor. This compares closely with the 30,000 which we should obtain. The variation is negligible.

Fig. 2 is a diagram plotted from a summary of the five heat balances calculated for various feed temperatures for "parallel current" operation, which represents the cycle used most extensively. The reader must bear in mind that in all these cases the total evaporation for the triple effect is the same—namely, 70,000 lb. per hour—and the total feed is the same, 100,000 lb. per hour. The only variation is in the temperature of this feed. The steam supply is then varied to give 70,000 lb. evaporation per hour in all cases. With the "parallel current" cycle the evaporation in each body does not vary as the temperature of the feed changes. By referring again to the heat balance shown in Table I the reason for this can be readily seen. In order to accomplish the evaporation required, the first body must produce 21,400 lb. of vapor. In order to do this, there must be available for evaporation 20,800,000 B.t.u. If the liquor enters at the boiling point, then we must put into the steam belt of the first effect 20,800,000 B.t.u. by condensing the corresponding amount of steam. If the feed is below the boiling point, we must add sufficient heat to bring it to a boil, increasing the steam consumption to that extent. If, on the other hand,

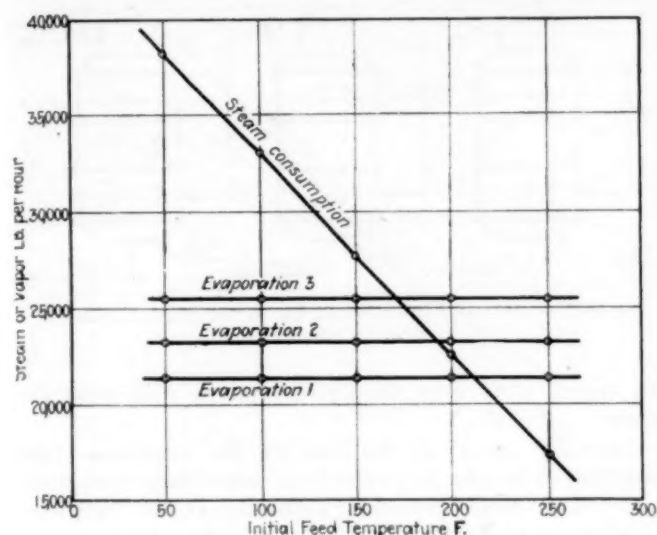


FIG. 3—TRIPLE EFFECT PERFORMANCE WITH PARALLEL CURRENT OPERATION AT VARYING TEMPERATURES

liquor enters above the boiling point, a corresponding flash takes place, liberating a certain amount of heat, thus decreasing the amount of steam required to make up the necessary 20,800,000 B.t.u. as vapor leaving the first body. The evaporation is greater in the second than in the first effect, and greater in the third than in the second, for reasons discussed previously. The temperature of the concentrated liquid is 125 deg. F. It must be noted that the steam consumption varies within rather wide limits as the feed temperature changes, a fact well worth remembering.

"COUNTER-CURRENT" HEAT BALANCE

We shall now go over the calculations for the "counter-current" heat balance, summarized in Table II. In this case we find it easier to work backward, inasmuch as the feed flows backward.

We begin by feeding into the third effect 100,000 lb. of liquor at the given temperature of 150. We evaporate by assumption 22,880 lb. at this point. The latent heat of steam at the existing temperature, 125, is 1,021.6 B.t.u. per pound, and the heat in this vapor is therefore 22,880 times 1,021.6, or 23,360,000. Part of this heat is derived from the flash or self-evaporation of the feed, 100,000 lb., which enters at 150 deg., dropping down to the boiling point, 125, and giving up 25 B.t.u. per pound, or a total of 2,500,000 B.t.u. Inasmuch as the vapor contains 23,360,000 B.t.u., as stated above, the difference, 20,860,000 B.t.u., must be made up by the condensation in the steam belt of the third

TABLE II—COUNTER-CURRENT HEAT BALANCE
Feed Temperature = 150 deg. F.

Specifications:	Heat	Liquor
(3) Vapor ex. 3 = $22,880 \times 26 \text{ lb.} = 22,880 \times 1,021.6 = 23,360,000$		100,000
Deduct flash, $100,000 \times (150 - 125 = 25) = 2,500,000$	2,500,000	22,880
Heat required S.B. 3.	20,860,000	77,120
$L @ 182 \text{ deg.} = 988.7. E_2 = \frac{20,860,000}{988.7} =$		$E_2 = 21,100$
(2) Vapor ex. 2.	20,860,000	56,020
Add for heating, $77,120 \times (182 - 125 = 57) = 4,400,000$	4,400,000	
Heat required S.B. 2.	25,260,000	
$L @ 209 = 972.2. E_1 = \frac{25,260,000}{972.2} =$		$E_1 = 26,000$
(1) Vapor ex. 1.	25,260,000	30,020
Add for heating $56,020 \times (209 - 182 = 27) = 1,511,000$	1,511,000	
Heat required S.B. 1.	26,771,000	
$L @ 227 \text{ deg.} = 960.7. \text{ Steam} = \frac{26,771,000}{960.7}$		27,850

effect of vapors from the second at a temperature of 182, having a latent heat of 988.7 B.t.u. per pound. The amount of vapor thus condensed will therefore be 20,860,000 divided by 988.7, or 21,100 lb., which of course represents the evaporation in the second effect.

The feed transferred from the third to the second effect is the total feed, 100,000 lb., less the evaporation in the third effect, shown above by assumption to be 22,880 lb., giving us 77,120.

In the second effect, we must supply not only the latent heat contained in the vapors going to the third, shown above to be 20,860,000 B.t.u., but in addition we must heat up the feed, 77,120 lb., transferred from the third effect at a temperature of 125 to the second at a temperature of 182, a rise of 57 deg., giving us 77,120 times 57, or 4,400,000 B.t.u., which when added to the latent heat of the vapor above, 20,860,000, gives 25,260,000 B.t.u. as the total heat requirements in the steam belt of the second body. Now the temperature of this steam is 209 and the latent heat for this is 972.2. The amount of steam condensed in the steam belt of the second effect will therefore be 25,260,000 divided by 972.2, or 26,000 lb., which is also the evaporation in the first effect.

The feed transferred from the second to the first effect will be the amount fed into the second from the third, 77,120, less the evaporation in the second, shown above to be 21,100, or 56,020 lb.

In the first effect, we must also provide heat enough to correspond to that contained in the vapors therefrom, given above as 25,260,000 B.t.u., plus the heat required to bring up the feed, 56,020 lb., from the temperature of the second body, 182, to the temperature of the first, 209, a rise of 27 deg., thus making up 56,020 times 27, or 1,511,000 B.t.u., which, when added to the heat in the vapors from this effect, 25,260,000, gives a total of 26,771,000 B.t.u. This heat must be supplied by condensing steam in the first steam belt at a temperature of 227, at which the latent heat of steam is 960.7 B.t.u. per pound. The quantity of steam required is therefore 26,771,000 divided by 960.7, or 27,850 lb. per hour.

The concentrated liquor discharged from the first effect will be the amount fed from the second to the first, 56,020, minus the evaporation in the first, shown above to be 26,000, giving us 30,020. In this case also, by premise, this quantity should be 30,000.

In Fig. 5 the heat balances are plotted graphically for different temperatures. The feed enters the third body, and is pumped from there to the second and then to the first, going in opposite direction to the steam, hence the name. The evaporation in each body varies considerably as the initial feed temperature changes. The steam consumption as well as the evaporation in the first and second effect decreases as the feed tem-

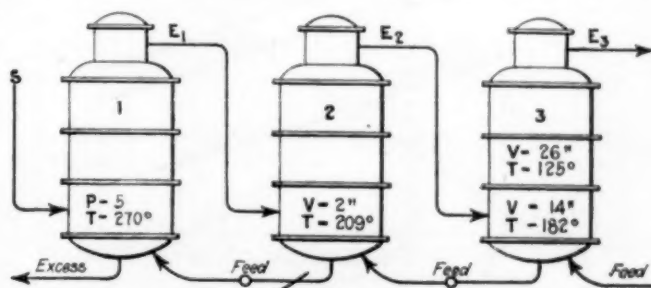


FIG. 4—DIAGRAMMATIC SKETCH OF COUNTER-CURRENT OPERATION

TABLE III—PARALLEL FEED HEAT BALANCE
Feed Temperature, 150 deg. F.

Specifications:	Heat	Evaporation
1) Heat available steam belt No. 1. 26,700 lb. at 5 lb. = $26,700 \times 960.7 =$	25,680,000	
Heat required per lb. evap. as follows: $L @ 209 =$	972.2	
Add for heating (70 per cent evap. 100		
$\frac{70}{100} \times (209 - 150 = 59) =$	84.3	
Total.....	1,056.5	
Evaporation 1 = $\frac{25,680,000}{1,056.5} =$		24,300
(2) Heat available steam belt No. 2. 24,300 lb. @ 209 deg. = $24,300 \times 972.2 =$	23,600,000	
Heat required per lb. evap. as follows: $L @ 182 =$	988.7	
Add for heating (70 per cent evaporation) 100		
$\frac{70}{100} \times (182 - 150 = 32) =$	45.7	
Total.....	1,034.4	
Evaporation 2 = $\frac{23,600,000}{1,034.4} =$		22,800
(3) Heat available steam belt No. 3. 22,800 lb. @ 182 deg. = $22,800 \times 988.7 =$	22,550,000	
Heat required per lb. evap. as follows: $L @ 125 \text{ deg} =$	1,021.6	
Deduct for flash (70 per cent evap.) 100		
$\frac{70}{100} \times (150 - 125 = 25) =$	35.7	
Total.....	985.9	
Evaporation 3 = $\frac{22,550,000}{985.9} =$		22,800
		69,900

perature increases. The evaporation in the third effect, however, does just the opposite. This is readily understood by studying the heat balance.

When the feed temperature is below 125, as it enters the last body, it must be heated up before it evaporates, thereby increasing the heat requirements in the steam belt. When this temperature, however, is higher than 125, a flash takes place, and this vapor is not used in multiple, but goes directly to the condenser. Thus, in the case of feed at 250, there is 12,500,000 B.t.u. liberated as flash and 17,750,000 of transmitted heat, making a total of 30,250,000 B.t.u. in vapor to the condenser. With temperature of feed at 50 deg. F., just the reverse takes place. There is 24,050,000 of transmitted heat, of which 7,500,000 is used in bringing the liquid to a boil and 16,550,000 represented as vapor.

It is to be noted that with counter-current operation there is a flash only in the last body and only when the temperature of the entering feed is above 125 deg. F., the boiling point. Except where there is a flash, each preceding body evaporates more than the succeeding one, for the liquid must be heated in each case before it evaporates, thus increasing the heat requirements of

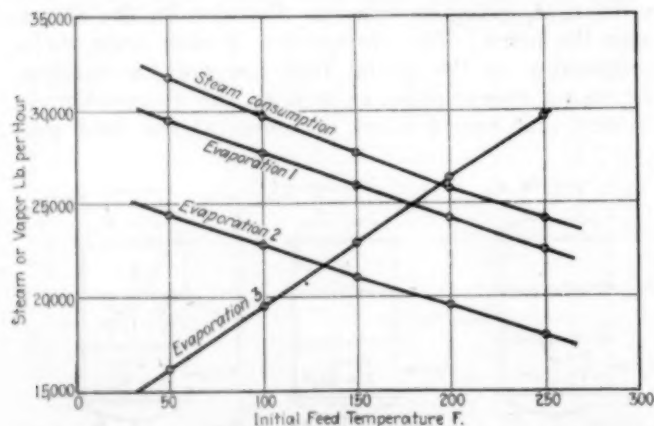


FIG. 5—TRIPLE EFFECT PERFORMANCE WITH COUNTER-CURRENT OPERATION AT VARYING TEMPERATURES.

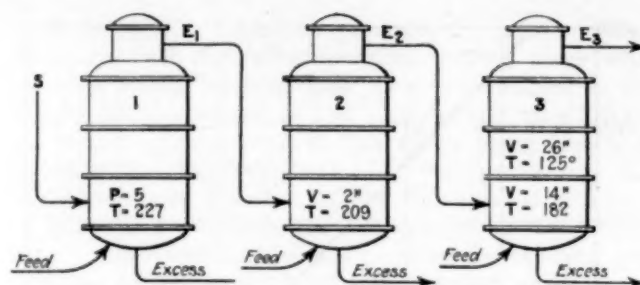


FIG. 6—DIAGRAMMATIC SKETCH OF PARALLEL FEED OPERATION

the second body over the third and the first over the second.

Generally speaking, the load on the condenser (the evaporation in the last effect) is much less than with "parallel current" operation, especially at low feed temperatures. It is also to be noted that the concentrated liquid leaves the first effect at a temperature of 209, as against 125 for parallel current operation, a fact well worth considering if subsequent heating operations are required after the concentrated material leaves the apparatus. When viscous materials are to be evaporated, it is very advantageous to operate "counter-current," as, in view of the high temperatures at high concentration, the annoying effects of high viscosity are very much reduced.

PARALLEL FEED HEAT BALANCE

Parallel feed heat balance is calculated with initial feed at 150 deg. F., as before. (Cf. Table III and Fig. 7.) We begin by admitting 26,700 lb. of steam into the calandria of the first effect, obtaining for useful work its latent heat at the existing temperature 227, which is 960.7 B.t.u. per pound. The heat thus liberated is therefore 25,680,000 B.t.u. Each pound evaporated will require in the first place an amount of heat equal to the latent heat at the temperature existing in the first effect, 209, or 972.2 B.t.u. This pound which we are to evaporate represents only 70 per cent of the corresponding liquor fed, for, by premise, we evaporate 70 per cent by weight in each body. We must heat this liquor from its initial temperature of 150 to the temperature of the first body, 209, a range of 59 deg.; therefore the amount of heat required for this operation will be 59 divided by 0.7, or 84.3 B.t.u. per pound of evaporation, which when added to the latent heat above, 972.2, gives a total of

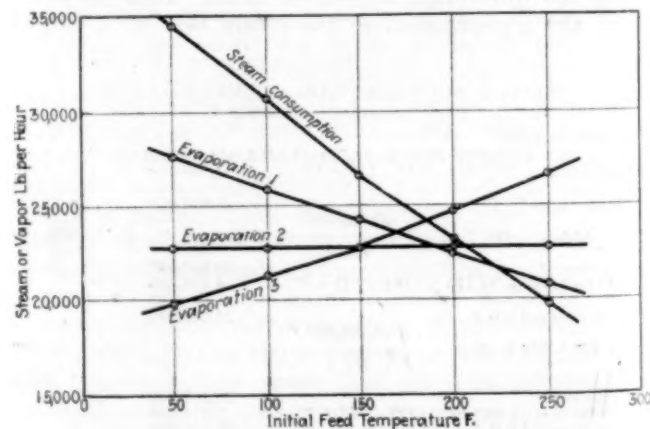


FIG. 7—TRIPLE EFFECT PERFORMANCE WITH PARALLEL FEED AT VARYING TEMPERATURES

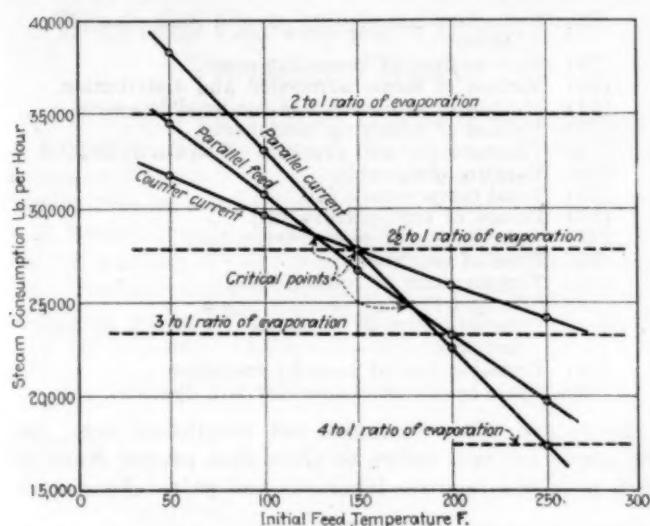


FIG. 8—COMPARISON OF STEAM CONSUMPTION WITH DIFFERENT METHODS OF OPERATION AND AT VARYING TEMPERATURES

1,056.5. The evaporation in the first effect will therefore be the total heat available given above as 25,680,000 divided by this 1,056.5, or 24,300 lb. per hour.

In the second effect, when this vapor condenses, it gives up its latent heat only, or 972.2 B.t.u. per pound. The available heat at this point will therefore be 24,300 times 972.2, or 23,600,000 B.t.u.

The heat required per pound of evaporation will be the latent heat at the temperature of the second effect, 182, which is 988.7, to which must be added the necessary amount to bring up the feed from 150 to 182, a rise of 32 deg. Here again the evaporation represents only 70 per cent of the liquor fed in, and this heating will therefore require 32 divided by 0.7, or 45.7, which when added to the latent heat above, 988.7, gives us 1,034.4 B.t.u. required for each pound of evaporation as before. The total heat available was shown above to be 23,600,000 B.t.u., and the evaporation is therefore 22,800 lb. per hour.

As in the case of the second effect, when this vapor condenses in the third steam belt it gives up only its latent heat, stated above as 988.7 B.t.u. per pound. The heat available for evaporation in the third effect is therefore 22,800 times 988.7, or 22,550,000 B.t.u.

The heat required per pound of evaporation will be, as before, the latent heat of steam at the temperature of the third effect, 125, which is 1,021.6. The correction for the heating effect in this case is negative, for the feed enters at a temperature of 150, which is 25 deg. higher than that of the third effect. A flash will therefore result liberating 25 divided by 0.7, or 35.7 B.t.u. per pound of evaporation. Deducting this from the latent heat of steam for this temperature, given above as 1,021.6, we have 985.9 B.t.u. as the amount of heat required for each pound of evaporation in the last effect. The available heat in vapors from the second body is given above as 22,550,000 B.t.u. The evaporation is therefore 22,800.

The total evaporation for the entire equipment is as follows:

First effect.....	24,300
Second effect.....	22,800
Third effect.....	22,800
Total.....	69,900

By premise this amount should be 70,000, and the discrepancy is therefore 100 lb. per hour.

In the case of "parallel feed" operation each body of the triple is fed independently, and the concentrated liquor removed separately from each. In performance, this cycle lies roughly between the other two. It has only very few limited applications in practice, and is discussed here more as a matter of interest. Perhaps its most important use is in the salt industry, where we start with saturated brine and the same concentration exists in each body. It is true that for a certain limited range it is more economical than either of the other two cycles, in this case, from feed at 125 to feed at 175. According to the temperature of the feed, there may be flashing in all bodies, heating in all bodies, or heating in some and flash in others. The steam consumption decreases as the temperature of the feed increases; so does the evaporation in the first effect. The evaporation in the second effect is practically constant, and in the third increases as the feed temperature increases.

Conclusions

VARIATION IN STEAM CONSUMPTION IN VARIOUS CYCLES

Fig. 8 shows a comparison of the steam consumption of the triple effect with varying feed temperatures, operated according to the various cycles suggested above. The crossing point of the parallel and counter-current curves is at a temperature of 150 deg. F. We wish to particularly warn our readers that this critical point applies only for our assumed conditions, and would be different if these conditions are changed. We can say, therefore, that under our prescribed conditions, the "parallel current" method of operation is more economical if the temperature of feed is above 150 deg. F., and the "counter-current" if this temperature is less than 150.

CONDENSER LOAD VARIATIONS

Fig. 9 indicates the varying load on the condenser, which of course is the same as the evaporation on the last effect. This is worked out for the three cycles for all temperatures. There is a decided advantage here in favor of the "counter-current" cycle at lower feed temperatures.

The amount of evaporation in every case is the same by premise for the whole equipment—namely, 70,000 lb. per hour. If we divide this figure by the steam consumption in any particular case, we have the ratio of evaporation in pounds of evaporation per pound of steam used in the equipment. These data we have worked out as shown in the accompanying log and Fig. 10.

In view of the discussion at the beginning of this article, it is of interest to note the wide divergence from accepted information. These curves also bring out very forcibly the importance of keeping the feed

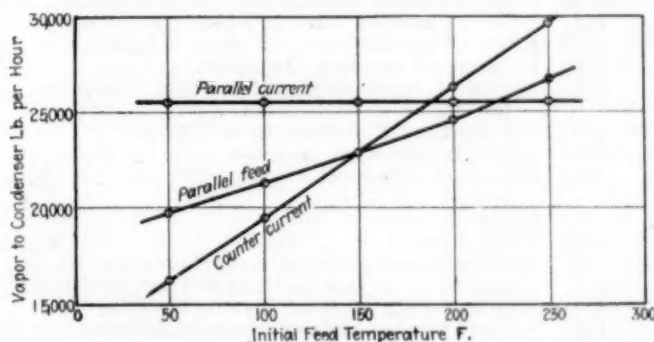


FIG. 9—CONDENSER LOAD UNDER VARYING CONDITIONS

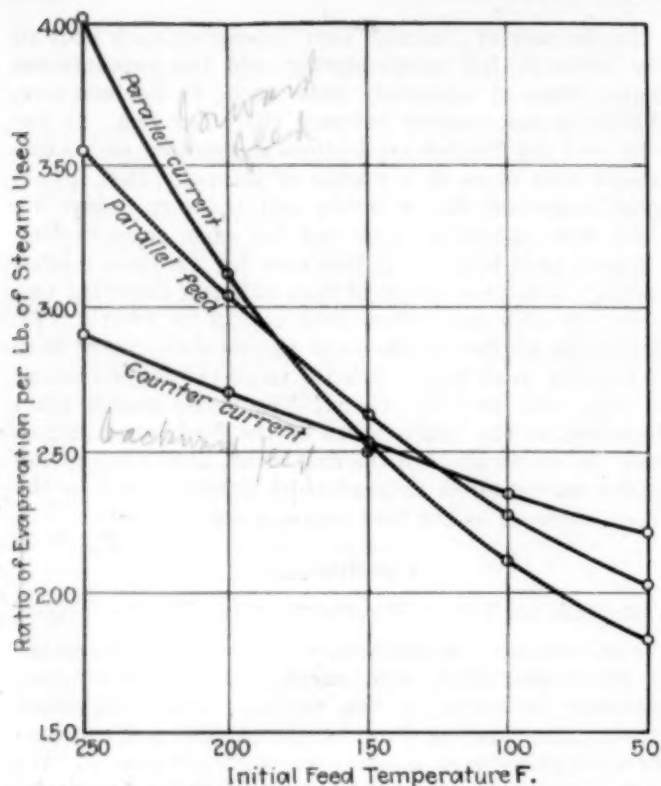


FIG. 10—EVAPORATION PER POUND OF STEAM UNDER VARYING CONDITIONS

temperature as hot as possible, and of keeping it so when once attained, if steam economy is of any consequence.

IMPORTANCE OF DETAILED STUDY OF EVAPORATOR PROBLEMS

There is a general tendency among both builders and users of evaporators to discount the importance and magnitude of a thorough analysis of their problems for the purpose of arriving at the best solution, and before closing, we cannot refrain from calling attention to the unusually large number of interrelated and independent variables which enter into this work. Below we have listed some of the more important items to consider:

- (1) Design of evaporator.
- (2) Size of evaporator.
- (3) Number of bodies possible, advisable and permissible.
- (4) Diameter of tubes.
- (5) Length of tubes.
- (6) Thickness of tubes.
- (7) Material of which they are made.
- (8) Material of which the evaporator is made.
- (9) Method of admitting feed.
- (10) Method of removing feed.
- (11) Method of feed control.
- (12) Level at which liquor is carried.
- (13) Proportion and arrangement of downtakes.
- (14) Effect of various rates of liquor circulation.
- (15) Effect of various rates of vapor circulation.
- (16) Influence of one over the other.
- (17) Merits of mechanical and natural circulation for the problem involved.
- (18) Composition of solution to be treated.
- (19) Initial temperature of same.
- (20) Maximum temperature to which it may be heated.
- (21) Initial density.
- (22) Final density.
- (23) Specific heat of solution at various densities.
- (24) Viscosity at various densities and temperatures.
- (25) Rise in boiling point at various densities.
- (26) Surface tension under various conditions.
- (27) Latent heat of solution under varying conditions.

- (28) Scale-forming constituents and their characteristics.
- (29) Best method of removing same.
- (30) Method of steam admission and distribution.
- (31) Method of removing non-condensable gases.
- (32) Method of removing condensate.
- (33) Temperature and pressure of steam available.
- (34) Vacuum obtainable.
- (35) Total temperature fall.
- (36) Losses of temperature fall.
- (37) Distribution of temperature fall.
- (38) Type of condenser.
- (39) Temperature of cooling water.
- (40) Size and type of vacuum pump.
- (41) Determination of probable coefficient of heat transfer.
- (42) Probable loss of heat by radiation.
- (43) Cycle by which evaporator will operate.

There are other variables not mentioned here, but the above list will suffice to show that proper study of such problems requires laborious and painstaking work.

Importance of Temperature and Humidity Conditions in Factories

The Bureau of Mines, in co-operation with the United States Public Health Service and the Society of Heating and Ventilating Engineers, is engaged in a study of the relative importance and correct correlation of the many individual factors concerned in the problem of the physiological effects of different conditions of temperature, humidity and air motion. A special room has been constructed for this purpose at the Pittsburgh station in which the air conditions are controlled by apparatus outside the chamber and entirely separate from it. A comprehensive program, which includes a quantitative study of a considerable number of bodily functions, is being carried out.

The work of the investigators has not yet been completed, but enough has been done to demonstrate the importance of determining the physiological reactions to environment as a measurement of the harmful effects of heat and humidity, and to show that feelings of discomfort as a standard of measurement cannot be depended upon because there is a certain adaptation of the sense organs to an unchanging environment, and individuals differ in their sense reactions.

Mineral Filler Investigation

In the course of the investigation of mineral fillers being made by W. M. Weigel, mineral technologist, at the Southern experiment station of the Bureau of Mines, Birmingham-Tuscaloosa, Ala., three special problems have been studied: Determination of grain size of fillers, involving elutriation and microscopic measurement, followed by methods of calculation; the effect of heat-treatment on the physical properties of white clays with respect to their use as fillers; and the utilization of Alabama flake graphite. The size of particle is a basic property of fillers upon which many of the other physical properties depend, consequently considerable work is being done in this direction. Work has been completed on the study of the effect of heat-treatment on the physical properties of clays. The lubrication tests on graphite were satisfactory, while results of the molding tests were negative. Experiments in the use of graphite as a remover of boiler scale were only partly satisfactory, being partly negative. A special investigation has been made of a series of clays from central Georgia and western Georgia with respect to their value as fillers.

Thermal Curves for Chromium-Vanadium Steels

AN EXTENDED REPORT of some co-operative work done by the Bureau of Standards and the Fixed Nitrogen Research Laboratory of the Department of Agriculture on chromium-vanadium steels was made by J. S. Vanick and W. W. Sveshnikoff, speaking before the Detroit meeting of the American Society for Steel Treating. First the thermal curves of plain carbon steels were compared with a series of steels containing Cr. 1.0, V 0.18, Mn 0.65 and Si 0.25, with carbon varying from 0.16 to 1.16. One such comparison follows:

	Ac ₁	Ac ₂	Ac ₃	Ar ₁	Ar ₂
Plain 0.34 C steel.....	734	764	787	680	750
0.30 Cr-V steel.....	768	764	807	697*	747*
0.30 Cr-V steel.....	..	..	..	709†	768†

*Cooled from 975 deg. C.

†Cooled from 852 deg. C.

Ac₁ and Ac₂ temperatures are raised by chromium, but the latter is lowered by the increasing carbon; the two points merge at about 760 deg. C. with 0.60 C (1.0 Cr, 0.18 V). As shown, Ac₁ is above Ac₂ for the low-carbon steels of this series, so the magnetic point cannot be used for hardening. An increase in the temperature from which the piece is cooled (T_{max}) is seen to lower Ar₁ and Ar₂, even in this low alloy.

Ar₁ point, however, is reasonably constant in position, and its intensity varies with the carbon content, therefore this arrest is probably due to carbon alone. Ac₁ is very difficult to determine from the thermal curves, but shows very plainly as a large increase in hardness when the quenching temperature passes that point.

A series of steels varying in vanadium content from 0.02 to 0.58 and containing C 0.35, Mn 0.50, Si 0.23 and Cr 1.05 were examined. The influence of V in these analyses is slight. Ac₁ and Ar₁ are both raised about 5 deg. C. for each 0.10 per cent V. Ar₂ is slightly raised by V; but 0.01 per cent carbon will overbalance seven times as much V. Vanadium is thought to enter a complex carbide for three reasons: (1) The intensity of Ar₁ varies as the carbon content; (2) T_{max} has no effect upon the Ar points as in Cr steels; and (3) the hardness vs. quenching temperature curves are similar to those of plain carbon steels, and a sample quenched from above Ac₁ shows no excess constituent.

Several chromium steels containing from 0 to 2½ per cent Cr and 0.35 C, 0.50 Mn, 0.2 Si and 0 to 0.3 V were investigated, together with three similar ones containing 7.7, 14.4 and 21 per cent Cr, respectively. As noted early in the paper, small amounts of Cr raise Ac₁; at 0.75 per cent Cr it merges with Ac₂, and at 3.1 per cent with Ac₃. Up to 7.7 Cr, however, Ac₁ remains unchanged, and therefore thus far there seems to be no free chromium in the annealed steel.¹ Beyond that point Ac₁ drops rapidly, reaching 675 deg. C. at 21 per cent Cr, an evidence that these high alloys have chromium dissolved in ferrite. Chromium carbide hinders the normal solubility of carbon in austenite, and also impedes the $\alpha \rightarrow \gamma$ change, thus raising both Ac₁ and Ac₂.

When cooling these low-chromium steels from 975 deg. C. at the rate of 7 seconds per deg. C., Ar₁ gradually lowers and Ar₂ gradually raises, the two merging at 2½ per cent Cr at about 710 deg. C.²

¹The analysis 7.7 per cent Cr, 0.37 per cent C agrees very closely to the formula Fe₃C.Cr₃C suggested by Murakami.

²At a hypothetical zero cooling rate, Ar₁ would occur at about 3 per cent Cr in steels containing 0.30 per cent C, a ratio corresponding to Edwards' proposed Cr₃C₂.

High-chromium steels show a "split" transformation on slow cooling from 975 deg. C., the upper portion being called Ar' and the lower Ar'', as is shown in the following table:

Cr Content	Ar'	Ar''
7.7 per cent	small, at 701	small, at 395
14 per cent	very small, at 695	large, at 387
21 per cent	none	feeble, at 350 to 170

Such effects of increased chromium can be produced to a degree in a single steel by increasing the rate of cooling, or by increasing T_{max} . Ar'' is exceedingly sensitive to changes in the cooling rate, producing corresponding changes in the structure and hardness.

These facts are explained by the supposition that the steel above Ac₁ contains chromium and carbon in solid solution, and upon cooling, the chromium retards the re-formation and accumulation of the carbides, stable at lower temperature. Furthermore, dissociation of carbides proceeds continuously upon heating past Ac₁, all free constituent disappearing from the microscopic field when the 7.7 Cr steel is heated to 950 deg. C. Increasing amounts of free Cr as T_{max} increases cause a strengthening of Ar''; more uniform distribution of the materials in solid solution at the high temperatures is thought by the authors to be responsible for the coincident suppression of Ar'. At maximum dispersion, Ar' should vanish and Ar'' be unaffected by further superheating.

Quenching the 7.7 or 14.4 per cent Cr steels from 1,000 deg. C. does not suppress Ar'', so the microstructure is coarse-grained martensite. Cooling to above Ar' and quenching give fine-grained martensite plus small globules of carbide, and a lower hardness. If the mass is cooled to within Ar' and quenched, there appear minute black specks of troostite throughout the ground mass. Cooling to below Ar' and quenching give a coarse-grained martensite outlined by thick troostite meshes. Quenched from within Ar'' shows some martensite grains, but distinct granulation in the troostite area. Slow cooling gives spheroidized carbides. Of course, since all these structures are unstable, with the exception of the latter, they depend upon the conditions existing at the time of their formation.

In explanation of the cooling curves shown and the structures obtained, the authors think that Ar'' is the suppressed Ar₁ transformation. The fact that a high-chromium steel showing only Ar'' may give martensite as a sole constituent upon quenching supports the French view that Ar'' is the lowered Ar₁ change (γ to α iron). The degree to which the Ar'' transformation has progressed marks the degree of martensitization of the austenite.

On the other hand, a split transformation (Ar'; Ar'') is invariably accompanied by the appearance of troostite in the structure.

The authors show that where Ar'' occurs with Ar' the former transformation is accompanied by the coalescence of carbides in the troostitic meshes. This leads them to the conclusion that when Ar' and Ar'' occur, the latter is a combination of Ar₁ and Ar₂. In such cases it is thought that Ar₂ proceeds to completion in the grain-like, austenomartensitic areas, while Ar₁, marked by the coalescence of the carbides, proceeds simultaneously in the troostitic meshes. Troostite actually granulates before the matrix changes, therefore Ar₁ proceeds to completion at Ar''.

³A feeble Ar₂ point shown at 675 deg. C.

The Colloid Mill and The Ultra-Filter Press

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The Impact and Friction Types of Colloid Mills—Various Proved and Suggested Uses for These Mills—The Ultra-Filter Press—Its Use With the Colloid Mill and Some Other Applications

IN SPITE of the constantly increasing appreciation of the importance of colloids in the industries there has not been any generally applicable industrial process for producing ordinarily massive substances in the colloidal state. Within the last 2½ years, however, Hermann Plauson, a Russian physical chemist, and Berthold Block, a German engineer, have published a series of articles* on a "colloid mill" which they have developed; and although our information in regard to this apparatus is limited, its promise is so great as to deserve our attention. By means of this colloid mill such various substances as coal, wood, phosphate rock and rubber can be reduced mechanically to stable colloidal suspensions, and applications of a novel nature have been developed in many unrelated processes.

The mill is the culmination of work carried on by Plauson for nearly 10 years, and its performance to date has demonstrated its remarkable possibilities in many lines. A surprisingly large number of technical problems have been attacked with its assistance, and the results claimed deserve the careful consideration of American chemists and engineers.

STILL IN THE DEVELOPMENT STAGE

It must be clearly understood at the outset that sufficient data are not yet available to enable the commercial value of this new equipment to be estimated accurately. The inventors are naturally enthusiastic in their claims; and there is much in the results already obtained to justify their enthusiasm. Although the processes described may be carried out as they say, there are still such undetermined factors as power costs, production capacity and depreciation. These, as well as the qualitative results, will determine the economic value of each projected process. It must also be stated that not all the claims for the mill appear to be well founded.

*See bibliography at end of article.

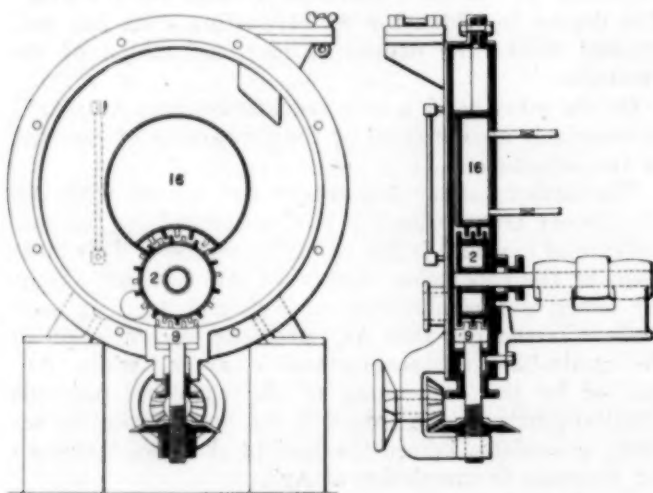


FIG. 1—THE IMPACT TYPE OF COLLOID MILL

With the exception of patents and a few articles by other writers, our only source of information are the publications of the inventors themselves in German magazines.

Plauson has attempted to protect his interests in the various developments with which he is concerned by applying freely for patents in various countries—Germany, Great Britain, France and the United States. By no means all of these patents have been granted at this date, and, as Frydlander suggests, it is somewhat questionable whether the mill itself can be patented. Many of its applications are, however, protected. The inventor's policy has been to sell territorial rights to the exploitation of his patents, and it is reported that arrangements are already complete for most of the industrial countries of the world. In the United States, the rights are owned by the Newport Co., Milwaukee, Wis.

THE IMPACT TYPE OF COLLOID MILL

Plauson believed that if any massive materials could be subdivided to particles between 1 and 0.01 microns in diameter and suspended in a non-conducting medium, colloidal solutions would result. With this in mind, he studied the effectiveness of the various grinding and crushing appliances in use and singled out impact mills as the most promising type for development. In the colloid mill he utilizes two principles which his work indicates are fundamental. First, in order to obtain extremely fine disintegration it is necessary to have the crushing force applied at high potential. For instance, if we consider the action of a hammer and anvil as exemplifying the process taking place, Plauson has determined that a hammer applied at the highest possible velocity is more effective than a heavy, slowly-moving one. The mill, therefore, operates at high speed. The second principle is that it is essential to disintegrate in a liquid medium, which serves to propagate the force of the blow in the same way that seawater transmits the explosive force of a depth bomb to the submarine which is to be destroyed. Accordingly, the charge fed to the mill consists either of two or more liquids or of a finely ground solid mixed with a considerable excess of the liquid used as dispersion medium.

HOW THE IMPACT MILL OPERATES

Plauson's first "colloid mill" is illustrated in the accompanying cut, Fig. 1. This represents an early form of the mill, and it very probably differs from the latest improved designs, although no later description of this type has been published. In this mill the toothed cylinder 2 rotates at very high speed, causing the teeth to beat the liquid charge and to throw it violently against the toothed resistance 9. The high speeds employed do not permit the liquid to flow around the teeth, so it is hammered just as when the surface of water is struck with the flat of the hand; and the force

of the blows which it receives is transmitted to the suspended particles, causing them to disintegrate. The electrical and heat effects produced by the violent impacts also tend to cause disintegration. The centrifugal action of the beater keeps the liquid at the circumference of the container and brings about a continuous circulation, so that new particles are constantly being subjected to the beater action. In order to control conditions more exactly, the mill is equipped with means for heating or cooling the charge as desired, by circulating water through the tank 16.

HIGH SPEED IN THE IMPACT MILL

The use of very high speeds is essential to successful operation. Peripheral speeds as high as 200 meters per second have been attained in a specially designed unit where the mill is driven by a direct-connected steam turbine. The corresponding rotating speed is 12,000 r.p.m., so the rotating beater must have a diameter of about 32 cm., about one-third that of the earlier mills described. The method of applying the power to drive mills at such speeds is in itself a problem. The direct turbine-driven unit appears to be the best design so far developed; but stepping-up gears specially designed for the purpose have been used for speeds around 6,000 r.p.m.; and direct drive by electric motor, or belt drive can be used for speeds not greatly in excess of 3,000 r.p.m.

The quantitative effect of speed on the size of particle obtainable is illustrated by the following figures cited by Plauson. If the peripheral speed is less than 10 meters per second, no better effect is obtained than by grinding in air (particles 0.001 mm. in size under best conditions). At 20 meters per second, an improvement is perceptible, and particles 0.0003 mm. in size are obtained; at 30 meters per second, particles of 0.0001 mm. are produced; and at 40 meters per second, true colloidal solutions. Higher speeds are actually used in order to accelerate the action.

THE FRICTION TYPE OF COLLOID MILL

It is obvious that the use of such high speeds as Plauson recommends (peripheral speeds of 1,000 meters per second are mentioned in some of his patent claims) introduces difficulties. The suggestion that the speeds of the moving members might be reduced by having adjacent parts rotate in opposite directions is a natural one and led to the development of another type of colloid mill. In this type, two grinding surfaces brought very near together are rotated at high speeds in opposite directions. This design is illustrated diagrammatically in Fig. 2.

The solid material to be ground (suspended in liquid as before) is forced axially under pressure into the space between the rotating disks 59 and 62, and after being subjected to the grinding or rubbing action is thrown into the chamber 64, from which it flows out through the outlet 65. The pressure between the disks is regulated by the lever 50 and the adjustable weight 51.

WHERE THE FRICTION MILL SHOULD BE USED

These two colloid mills are adapted to somewhat different uses, though it is not always clear to which type reference is made in accounts of the various applications. The impact type of mill is the one first developed by Plauson, and with it he was able to achieve many novel results with varied materials. The friction type

of mill is apparently a later development, though less original in design. According to the inventor, it is the one better adapted to making colloidal solutions from massive, non-colloidal material. The impact mill, on the other hand, is better adapted for use with emulsifiable liquids or naturally occurring colloids such as gelatine, rubber, gums, etc. It can also be used on solid material, but apparently the high speeds necessary for its effective operation on such material offer difficulties of design or are not economical. Indeed, when Plauson's early articles are considered, it may be suspected that the development of the friction mill was due to the fact that the impact type did not come fully up to his expectations.

THE TECHNIQUE OF MAKING COLLOIDAL SOLUTIONS

Working with the mills just described, Plauson obtained many interesting results, some of which could have been predicted from our knowledge of colloids. As already mentioned, Plauson considered the manufacture of colloids to be merely a mechanical process of disintegration in a non-conducting liquid medium. His early experiments show how very important it is that the liquid medium actually be non-conducting. The presence of very small amounts even of weak electrolytes, formed by hydrolysis from the material under treatment, renders it impossible to obtain particles sufficiently small to form a colloidal solution. The most rigid precautions have to be taken to preclude the presence of electrolytes.

Another interesting phenomenon which Plauson observed is that of saturation. He found that it is not possible to take any two substances, say *A* and *B*, in any proportions whatever and by means of the mill

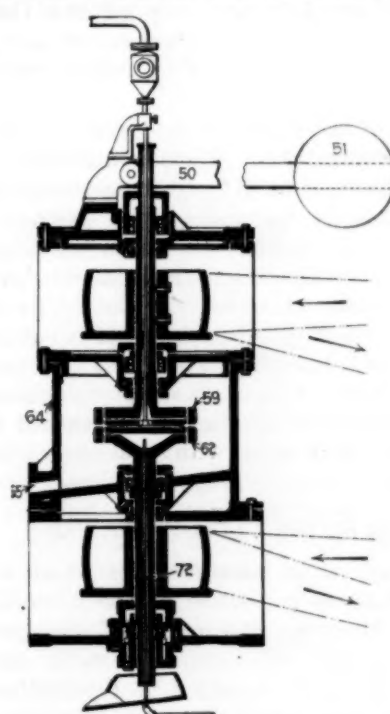


FIG. 2—THE FRICTION TYPE OF COLLOID MILL

produce a colloidal solution of that composition. Only a definite concentration of *A* in *B* can be attained; and if there is an excess of *A*, another phase forms, a solution of *B* in *A*. Plauson calls these colloidal solutions, to which no more of the dispersed phase can be added, saturated solutions in analogy to the solubility relations

of solids in liquids. No amount of treatment in the colloid mill serves to produce solutions of higher concentration than these saturation values. It was found, moreover, that this relationship is very specific, depending on the nature of the dispersed phase and of the dispersion medium. As illustrations the following figures may be cited showing the saturation concentration of copal in various dispersion media:

	Per Cent		Per Cent
Benzene	1.8	Glycerine	2.8+
Water	2.2	Amyl alcohol	5.0+

It may be noted that Plauson found thus two difficulties to be overcome in technical applications of his mill: one the deleterious effect of even small amounts of electrolytes, and the other the formation of saturated solutions, many of such low concentration as to be of little commercial value. In the use of "dispersors" Plauson found a means of overcoming partly both of these difficulties. He found that small amounts of "dispersors" (protective colloids or, as we should more commonly say, peptizing agents) added to the mixtures to be treated neutralize to a large extent the influence of weak electrolytes in small concentration, and also enable solutions of much higher concentration to be produced.

These dispersors, to use Plauson's term, are of the utmost technical importance. They are used in almost every commercial application, and the selection of a properly functioning dispersor may be the critical point in many technical problems. Several illustrations of the use of dispersors may be given. Glue (partly decomposed with alkali) is added in manufacturing colloidal solutions of coal. Tannin accelerates the disintegration of graphite, and soap solution that of talc. Sugar is used in grinding mineral colors, and glycerine in making colloidal solutions of iodine, mercury and sulphur.

The action of the dispersor is specific, as may be seen from these illustrations. Plauson distinguishes three classes of dispersors: (1) substances capable of dissolving the material to be dispersed (without forming electrolytes)—for example, alcohol in the dispersion of phenol condensation products in benzene or water; (2) substances which, with the material to be dispersed, form reactive chemical compounds with colloidal properties—e.g., potash with fats and oils; (3) substances which are capable of forming complex compounds with chemically indifferent substances, but cannot form free ions. Tannic acid used with coal or carbon is an instance of this class.

USE OF THE ULTRA-FILTER PRESS

Another way out of the difficulties which arise from too dilute solutions is by use of the ultra-filter press invented by Plauson. By means of this press thick colloidal pastes may be obtained directly from dilute solutions simply and cheaply. A description of this equipment is given at the end of this article. The colloid mills and the ultra-filter press are complementary, for the mills could not realize their full possibilities without the aid of the press in concentrating the dilute solutions produced. Where it is desired to disperse a substance completely, the procedure followed is to treat it with a dispersion medium in the mill until a satisfactory colloidal solution is obtained. Ordinarily only a part of the material will be colloided. The solution is

separated from the non-colloidal residue by settling or ordinary filtration and the residue returned to the mill for further treatment. The dispersion medium is recovered from the solution by filtration in the ultra-filter press, and the dispersed material, on the other hand, is ejected from the press in the form of a viscous solution or paste.

INDUSTRIAL APPLICATIONS OF THE COLLOID MILLS

The many applications already devised for the mills may be classified according to the nature of the action effected. The mill may be used simply for stirring—for example, in dissolving salts. Plauson claims that it is very effective in such work; and it probably is, though hardly economical. In some instances, the mills are used merely to produce very fine grinding, as in the case of pigments, or to produce suspensions or emulsions; in others, they are used for the extraction by selective emulsification of one or more constituents from a mixture; it has, for instance, been used for recovering oil from shale. There are also many processes where the mills are used to induce or accelerate chemical reactions.

As an instance of the use of the mills merely to produce an extremely finely divided product, the disintegration of phosphate rock for fertilizer may be mentioned. It is claimed that the rock can be reduced to so fine a powder that it is directly assimilable by plants without being treated with sulphuric acid. It is also stated that in compounding rubber the mill yields products of exceptional excellence owing to the fineness of disintegration and the homogeneity of the resulting mix. The grinding of pigments in the mill—for example, ultramarines—greatly increases the brilliancy of hue. Blanc fixe can be made merely by milling barytes.

MAKING PLASTIC CELLULOSE

The manufacture of plastic cellulose is another accomplishment of the colloid mill. Wood is reduced by grinding to a fine powder and the finest particles are separated by air and mixed with a large volume of water to which a small amount of alkali or other dispersor is added. After treatment in the mill, the resulting colloidal solution is precipitated with acid and the cellulose gel carefully washed free of salts and dried *in vacuo* to prevent the action of air. The powdered or gel cellulose thus obtained may be molded hot, and the resultant product possesses excellent mechanical properties as well as high di-electric strength. Its tensile strength is 300 to 500 kg. per square centimeter, it machines well, and a plate 3.5 mm. thick will withstand a potential of 55,000 volts.

The ability to make stable solutions, regardless of the solubility relationships of the different constituents, enables lacquers and varnishes of an entirely new type to be developed. The desired gums can be dispersed in any cheap solvent by means of the colloid mill. While a variety of such varnishes has been prepared, their properties have not been reported in any detail. The possibility is, however, a very attractive one.

MAKING EMULSIONS

In making emulsions of oil and water, Plauson believes that he has developed a new type of lubricant which, while very effective, is extremely economical on account

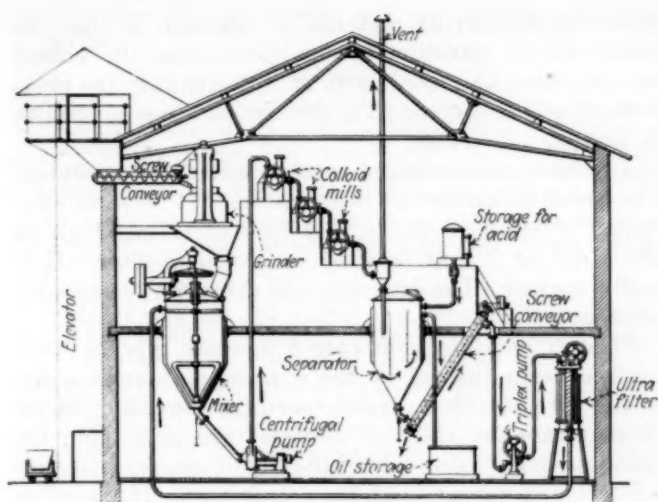


FIG. 3—PLANT FOR OBTAINING NAPHTHA FROM BITUMINOUS SHALE

of the considerable water content. If, for example, a mixture of two parts of oil and two to three parts of water are emulsified, a thick, pasty grease is obtained. It is possible to add to this paste solid lubricants such as graphite, talc, etc., and the lubricating mixtures thus formed carry heavy loads very well. Plauson points out that such lubricants are perfectly neutral and asserts that the emulsions are very stable. In Germany, where oils and fats are scarce, their economic advantages will be much more appreciated than they would be here.

One of the industrial applications of the mill for which the inventor feels there is exceptional promise is the making of "liquid coal," a colloidal suspension of coal in fuel oil. Thirty to forty parts of powdered coal is mixed with seventy to sixty parts of fuel oil, a suitable dispersor is added, and the mixture treated in the mill at high speeds $\frac{1}{2}$ to 3 hours. The resultant sirupy liquid can be burned like other liquid fuels, but has, of course, a higher heating value per unit volume, which makes it especially desirable for marine work. As much as 15 per cent water can be added to the mixture without causing precipitation of the coal.

SEPARATION BY COLLOIDAL MILL

In many instances Plauson has used the colloid mills for the separation of difficultly separable mixtures by colloidizing one of the constituents. A process which he says was received very favorably in this country (presumably on the experimental scale) is the recovery of naphtha from petroleum slimes or shales. Some of these contain so large a portion of earthy material that separation by distillation is not feasible. Plauson proposes, therefore, to treat the finely ground shale in the mill with a large excess of water, with which the naphtha forms an emulsion. From the resulting mixture the mud settles rapidly on standing, permitting the emulsion to be drawn off, and the naphtha and water are then separated by heating. It is claimed that from an original content of 24.6 per cent oil, a yield of 19.8 per cent was obtained, and further oil was extracted by subsequent treatment. A diagram of a plant operating on a slight modification of this process is shown in Fig. 3. The shale is ground, mixed with water, and fed to three colloid mills operating in series. Acid is used to break up the resultant oil-water emulsion, and the oil is separated by gravity. The mud and water are then con-

veyed to a filter press and the water, still containing some oil, is returned to the system. This method is, of course, applicable only to those shales, well known both in this country and in Russia, from which the oil can be extracted with solvents.

SOME ILL-FOUNDED CLAIMS

An instance in which the claims for the colloid mill appear to be ill-founded is in the manufacture of colloidal resins. It was stated in one of Plauson's early contributions that by treating crude domestic (German) resins in the mill a colloidal suspension of the true resin could be obtained very economically. In fact, a company was organized to exploit these colloidal resins. Their success must have been very limited, however, since a correspondent of the *Seifensieder-Zeitung* pointed out very emphatically that such resins were by no means pure; that in addition to large amounts of water which had been incorporated with them, the original impurities were still present; and that, due to the treatment in the mill, these impurities were so thoroughly incorporated that no economical method was available for purifying the product.

This case reminds us that the colloid mill cannot be a panacea for all industrial ills. In the enthusiasm of discovery, claims are doubtless made which will not be substantiated by experience. While there are many cases where separation can be effected, as in the extraction of oil from petroleum shales, or of vegetable oils from oil-cake, there are also many cases where treatment in the mill will serve to render the impurities much more difficultly removable than before. It must be realized, however, that mistaken applications should not prevent the real merits of the mill from being appreciated.

ACCELERATING CHEMICAL ACTION BY USE OF COLLOIDAL MILL

There are many cases in which the mill is used to accelerate chemical reactions. One of the more recent of these is in the making of viscose for artificial silk, plastics, etc., and this is an excellent example of the use of the mill for such purposes. By treating the cellulose first in the colloid mill, it is reduced to the colloidal state, and is then in a condition to react directly with the theoretical amount of alkali to form the monosodium derivative. This reaction is carried out in the mill, as well as the following step in which the carbon bisulphide enters into the reaction. For this process the following advantages are claimed: (1) The action of the theoretical quantity of alkali is possible at ordinary temperatures. (2) The reaction time is considerably shortened, so there is less hydration and decomposition of the cellulose by the alkali and consequently less contamination with byproducts. (3) No treatment with acid is necessary at any stage. (4) Less carbon bisulphide is used, and the reaction proceeds very smoothly. (5) The viscose solution obtained is very pure. (6) A long ripening of the viscose is not necessary. It can usually be used in a few hours. (7) The silk produced from the viscose is of higher quality and is produced at less expense.

In the cuprammonium process the colloid mill can be used in a similar manner.

The reduction of the cellulose particles to colloid size makes them, of course, very susceptible to any chemical action, and the saccharification of cellulose as a pre-

liminary step in the manufacture of alcohol from wood-waste is very greatly accelerated by using the cellulose in this form.

HYDROGENATION OF OILS

A quite different application of the mill in accelerating chemical reactions is in the hydrogenation of oils. The very thorough mixing of the hydrogen and the oils which may be obtained by this means greatly increases the velocity of reaction. Plauson found, too, that instead of adding a catalyzer of powdered nickel to the oil before hydrogenation, it was sufficient if the parts of the mill in contact with the oil were covered with nickel. This proved to be a convenient and effective method of operation.

Still another use of the mill in this field is in the soap industry. By treating the fats and oils with caustic alkali in the mill, the reaction time is greatly

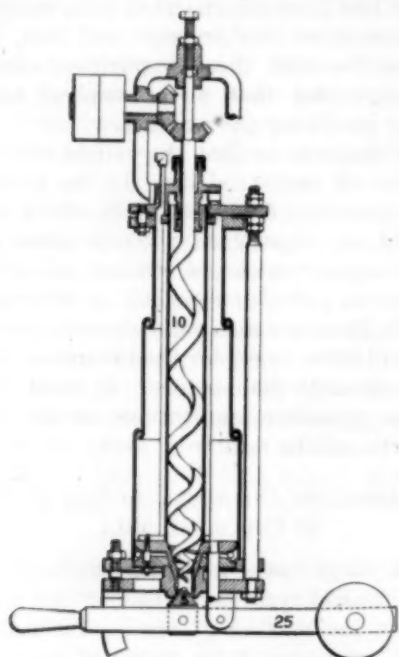


FIG. 4—THE ULTRA-FILTER PRESS

reduced and a very uniform product is secured. Little supervision is necessary, and one man can run several mills, so the operating expense is considerably reduced.

THE ULTRA-FILTER PRESS

Reference has already been made to the ultra-filter press. Its design is shown diagrammatically in Fig. 4. The outside is constructed with telescopic joints. The charge is pumped in at the top and the solids are forced constantly downward by the screw 10 till discharged through the conical joint 3. The pressure required to expel this material is regulated by the lever 25 and an adjustable weight. The filtering surface is the cylinder surrounding the screw 10 and consists of several superimposed perforated metal sheets, the pressure between which may be regulated by means of a screw. The particles of precipitate gradually obstruct the small interstices formed by these sheets and thus build up a cake which effectually prevents the passage of further colloidal particles, but which does permit the liquid to pass through. In some cases a preliminary cake may be built up of plaster of paris, or asbestos, or similar materials. The revolving screw maintains a constant

thickness of filtering material on the wall so that the conditions of filtration are uniform; and the colloid becomes more and more pasty as it descends in the press until it is discharged. The filtrate obtained is said to be exceptionally clear.

A number of advantages are claimed for this design. The press is continuous in operation. It uses no filter cloth. It operates under high pressures (as high as 200 atm.) or it may be used as a vacuum filter. It is easily washed. The pore size and thickness of cake are adjustable.

Plauson has also constructed another type of filter surface using instead of the wire mesh fabrics a coil of fine wire outside a coarsely perforated metal cylinder. In that case the colloidal particles gradually plug the spiral passages along which the liquid escapes and thus a filtering membrane is formed as before. If the wires used are wound with cotton, or paper, and the like, an especially effective filter is obtained.

APPLICATIONS OF THESE NEW FILTER PRESSES

The ultra-filter press has found many industrial applications apart from its use in conjunction with the mills. In the beet sugar industry, for instance, the juice is subjected at present to a purification process which consists in treating it with lime and subsequently charging the solution with carbon dioxide. The precipitate, which in addition to calcium carbonate contains many of the organic impurities, is removed by filtration. This whole process, which requires considerable time and equipment, may be eliminated by filtering the juice directly through the ultra-filter press—previously adding only a small amount of lime to decompose non-sugar substances.

In the ceramic industries, also, the filter press has a large field in the dehydration of clays.

Another use of the ultra-filter press is in the crushing of oil seeds and in the purification of oils. The oil seeds after the usual cooking may be treated directly in the press, which operates like an expeller press. The oil, being thus simultaneously subjected to a filtration, leaves the press clear and free from albuminous matter. Crude oils may readily be purified by treatment with barium hydroxide solution in the colloid mill and subsequent filtration in the ultra-filter press with a pore size of 0.4 to 0.1 μ . By this means, not only the coarser contaminations such as albumins are removed, but also the coloring material; so that a pure, clear oil flows out. The use of the filter press in conjunction with the mill has also proved effective in removing oil from substances containing it such as anthracene, paraffine, etc.

By making the pores sufficiently fine, it is even possible to prevent the passage of bacteria, and it is suggested that the filter may find application in water purification, where its compactness will be an advantage over the extensive filter beds now in use.

CONCLUSION

The various applications cited above are by no means all those mentioned in the articles already published; and they certainly do not exhaust the possibilities of the new machines described. Very possibly many of the processes described may not prove to be commercially successful, but certainly this new technique for producing colloids on an industrial scale offers an opportunity for the solution of many difficulties and opens up

possibilities of a varied nature to the chemical technologist.

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Small Electric Furnaces for Experimental Heats

During the war a large number of special alloys were tested by various agencies to determine their fitness for munitions. One series, made by H. W. Gillett and E. L. Mack,¹ was for determining their resistance to erosion by hot explosive gases. For this purpose, a sound ingot weighing 30 lb. was sufficient.

A small single-phase direct-arc furnace was first tried. The iron shell 11x15x13 in. high was lined with magnesite brick 1½ in. thick; the bottom rammed up with magnesite and water glass, and the top covered with a zirkite brick slab. Side walls were water-cooled. Graphite electrodes, 2 in. in diameter, were set 2 in. apart, and carried 500 to 700 amp. at 75 to 90 volts. At first an iron mold was filled direct from the furnace. This practice always resulted in gassy steel, and a pre-heated ladle was later used. Sound ingots resulted from a lower pouring temperature. The furnace was unsatisfactory, however, because from 0.2 to 0.6 lb. graphite was taken from the electrodes in restarting the arc during melting down. With such a small charge, this was responsible for wide variations in the carbon content of the resulting steel. The thin side walls also

spalled badly—zirkite brick did better, lasting fourteen heats.

A cylindrical furnace, much like a rocking brass furnace,² was then built, and proved very satisfactory for making about 200 intermittent heats of high-alloy steels. From operating experience, the authors recommended the following: The furnace should have a steel shell, 32½ in. in diameter and 45 in. long. The outer lining should be 1 in. of Sil-O-Cel or some similar reliable low-temperature insulator; a second layer 2½ in. thick of high-grade aluminous (corundite) firebrick; the third layer consisting of 4-in. magnesite brick in the lower or hearth half, and bare Carbofrax in the roof. If the furnace is to do refining, the hearth should then be covered with electrically sintered, dextrin-bonded magnesia. If a mere series of similar melts is to be made, the hearth is preferably lined with 1 to 2 in. of alundum cement, rammed in in layers, each layer being dried thoroughly with a gas flame and moistened with a thin wash of alundum before a fresh layer is placed and dried.

The furnace ends should be built of magnesite blocks with a total thickness of 15 in., and the corners filled with alundum so that the hearth is a roughly spherical chamber, 14 in. in diameter.

Such a thick end wall forms an admirable support for the electrodes. There are to be 2 in. graphite rods, 40 to 48 in. long. Split bronze castings may be used for connectors, good contact being insured by wrapping the carbon with copper gauze. When the electrode shortens so the connection becomes hot, it may be covered with asbestos cloth kept wet by a water drip. Adjustment may be done by hand. When charging or repairing the lining, the electrode hole should be punched with a 2½-in. steel bar.

A 12-in. square opening in the shell forms a charging and pouring opening. It is to be closed by a plug of carborundum brick, cemented and covered with alundum cement. The door is iron bound and held in place by keying to eye-bolts attached to the furnace shell. After charging, the door and electrode openings should be luted with alundum cement, and as the furnace heats up, any cracks are brushed with thin wash. In this manner the furnace is kept air-tight.

The entire furnace should be bound with two iron hoops, running on trunnions. Iron levers attached to the side permit rotation by hand when pouring and patching the lining. During melting the furnace is stationary.

Such a furnace takes from 60 to 70 minutes to pre-heat the lining. A current of 500 to 750 amp. at 60 to 90 volts will be required. After charging and closing the furnace, it is run until a calculated amount of power is put in, as experience with similar conditions requires (40 to 50 kw.-hr. for a 50-lb. charge).

Molybdenum and Cerium Alloy Steels

In the study of molybdenum and cerium alloy steels at the Ithaca, N. Y., field office of the Bureau of Mines, endurance tests on bars taken both with and across the direction of rolling show that the relationship between endurance and tensile strength (or hardness), which holds fairly closely for longitudinal bars, does not hold nearly as well on transverse bars. The endurance of transverse bars is lower, and the amount by which they are lower appears to depend primarily on the type, size, number and distribution of the non-metallic inclusions.

¹Bulletin 199, Bureau of Mines; "Experimental Production of Alloy Steels."

²"A Rocking Electric Brass Furnace," by H. W. Gillett and A. E. Rhoads. *Met. & Chem. Eng.*, vol. 18, p. 583.

Cored Structure in Quenched Manganese Steel

BY SERGIUS S. BELIAEFF

FOR close examination a polished surface of steel is usually etched with an acid or some other solution to develop its structure. A number of different solutions are employed, depending on the alloy or steel used and the characteristic it is desired to study. But all those reagents could be divided into two groups. In Group I would be classed etching reagents for micro-examination—in other words, the examination of the structure of steel under high magnification (from 20 up to 1,000 times). Reagents in Group II are used for studies at low magnification, such as two or three diameters, or even at natural size with the naked eye. Sometimes very interesting results are obtained by using a reagent of Group I in parallel with those of Group II or of a deep pickling with acid.

An entirely different structure may be obtained from the same sample of manganese steel which has been etched with a reagent of Group I, by repolishing and etching with a reagent of Group II. For instance, Fig. 1 is cast manganese steel (C 1.25 and Mn 12.0 per cent), which has been quenched in water from 1,850 deg. F. and etched with 3 per cent nital. At 100 diameters it shows typical austenitic network structures, with inclusions of free manganiferous carbide. Fig. 2, on the other hand, is a photograph of the same surface after it has been repolished and etched with Le Chatelier's solution¹ No. 1. This shows typical dendritic structure.

Both photographs are practically of the same magnification, but their appearance is totally different; at first sight they have no relation whatsoever. But if a photograph is taken from the same specimen after double etching, but without repolishing between the nital and the cupric reagent, a close connection is found between the grain boundaries of austenite and dendrites.

The deposit of copper must be washed off with strong ammonia before photographing. This method of etching not only develops the grain of the alloy but even reveals non-homogeneity in the grain itself, showing

¹Copper chloride 10 grams, magnesium chloride 40 grams, hydrochloric acid 20 c.c., water 180 c.c., and methyl alcohol 1,000 c.c.

that each dendrite forms a crystal, even after a quench from 1,850.

A sample of the same steel in its cast condition, etched with nital, has the same structure as Fig. 2, which was etched with copper solution after heat-treating. The typical dendritic structure of cast manganese steel, revealed by etching with nital, was apparently entirely changed by heat-treating into a network of austenitic grains. This is true as far as can be shown by etching with nitric acid, but by etching with Le Chatelier's solution or other reagent, each grain of austenite will be shown to contain many features of the original dendrite.

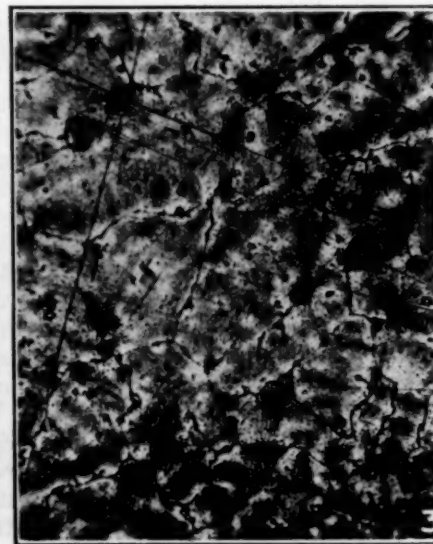
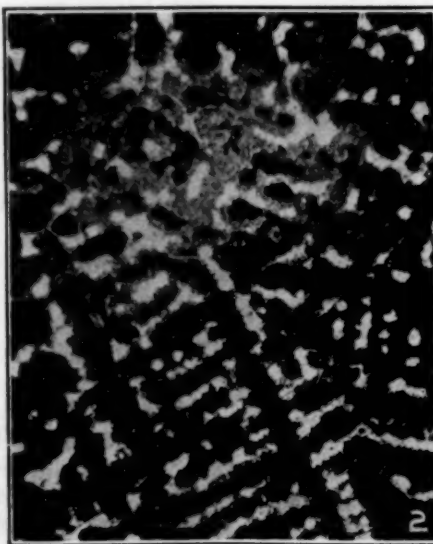
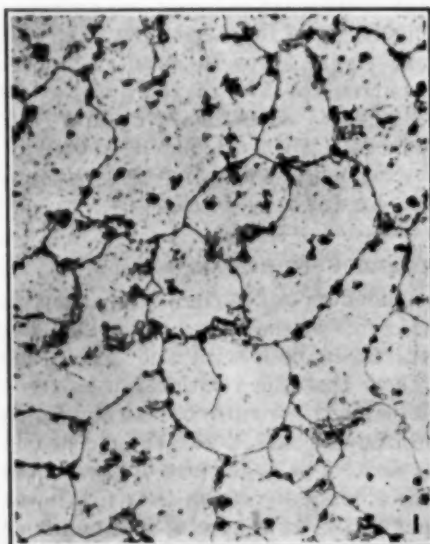
British Experiments in Enamel-Kiln Firing

A series of interesting experiments in connection with the insulation of enamel kilns has been carried out recently by a British firm, according to an article in the *Staffordshire Gazette*.

In enamel kilns, owing to the radiation of heat from the iron doors, difficulty is experienced in firing up the ware in front of the kiln, so that the custom is to fill the front with ware requiring slight firing as compared with the goods in the other parts of the kiln. The experiments have been directed toward preventing the loss of heat by radiation and obtaining uniformity of temperature throughout the kiln. It is stated that success in the experiments has been obtained by the firm after numerous attempts.

To prevent the radiation of heat, a mattress packed with blue asbestos fiber has been constructed on an iron frame to cover the kiln doors. In blue asbestos there is a stronger fiber and a better heat resistance, and it is claimed that this mattress retains practically all the heat that would otherwise be wasted in the kiln. Obviously this increases the temperature in the front of the kiln, and the ware in the front of the kiln can be fired just as in any other part. It is essential that the doors of the kiln should be lined with firebrick. This prevents damage being done to the mattress through the doors becoming too hot. The iron doors, of course, become much hotter than they do without the mattress, as a result of the heat being kept in by the mattress.

The apparatus is quite simple and inexpensive and is actually only an application of the asbestos covering of boilers and steam pipes in pottery ovens.



FIGS. 1 TO 3—STRUCTURE OF QUENCHED MANGANESE STEEL

Fig. 1—Etched with 3 per cent nital; $\times 100$.

Fig. 2—Etched with LeChatelier's solution No. 1. $\times 120$.

Fig. 3—Etched with both in succession and washed in NH_4OH . $\times 100$.

Ethylene From Trent Amalgams As a Source of Alcohol

BY J. D. DAVIS

Research Chemist, Pittsburgh Experiment Station
U. S. Bureau of Mines

SIXTY YEARS AGO M. Berthelot found that ethylene could be selectively absorbed from gaseous mixtures by concentrated sulphuric acid and that the compound formed by the chemical union of the gas and acid was readily decomposed by heating with water, yielding ethyl alcohol. Only within the last few years has there been any attempt to make use of this discovery technically. Bury,¹ working in England at the Skinningrove Iron Works and on a commercial scale, developed a technical method for converting the ethylene of coke-oven gas into alcohol. With a gas containing less than 3 per cent of ethylene, he obtained a yield of 1.6 gal. of alcohol per ton of coal carbonized.

De Loisy² perfected a technical method for treatment of coke-oven gas for alcohol. Evidently this work was carried out on a semi-commercial scale. His method is based on the use of catalytic agents for hastening the absorption of ethylene by sulphuric acid. He uses part of the spent acid for drying the gases and part for the manufacture of ammonium sulphate. Excess acid is re-concentrated by waste heat. Others have worked on the problem, but so far there has been no large recovery of ethylene from coke-oven gases. The chief difficulty seems to lie in the low efficiency (about 50 per cent) of methods and the relatively low concentrations of ethylene in the gases treated. Gas from Trent amalgam³ contains much larger percentages of ethylene than

TABLE I—ANALYSIS OF MATERIALS USED

Big Muddy Coal	
	Per Cent
Moisture.....	5.78
Volatile matter.....	31.87
Fixed carbon.....	52.42
Ash.....	9.93
Total.....	100.00
Sulphur.....	1.28
Fractionation of the Navy Fuel Oil	
Temperature Range, Deg. C.	Per Cent Distilling
130.....	First drop
130 to 225.....	1.1
225 to 250.....	4.81
250 to 275.....	14.25
275 to 300.....	20.10
300 to 325.....	21.70
325 to 350.....	30.90
Residue.....	5.82
Loss.....	1.31
Specific gravity of the oil at 20 deg. C.....	0.868

tilled at all temperatures from the decomposition point of the coal to the highest retort temperature, and no definite temperature can be fixed on as the temperature of distillation. With the method here used, the distillation range was made narrow. This was effected by feeding the charge regularly into a retort kept at constant temperature—that is, the predetermined distillation temperature. Distillations were conducted at temperatures 400, 500, 600, 700 and 800 deg. C., and the gases evolved were measured and analyzed. Samples of the coal and oil used to prepare the amalgams were distilled under the same conditions as were the amalgams for purposes of comparison.

EXPERIMENTAL RESULTS

The materials used in the experiments were Illinois coal obtained from the Big Muddy Coal & Iron Co.,

TABLE II—ANALYSES OF GASES FROM TRENT AMALGAMS, COAL AND OIL

Charge	Temp., Deg. C.	CO ₂	C ₂ H ₂	O ₂	CO	CH ₄	C ₂ H ₄	H ₂	N ₂	B.t.u. Per Cu.Ft.	Yield, Cu.Ft. Per Ton	Oil From Gas, Gal. Per Ton	Remarks
Amalgam.....	400	9.8	23.4	0.6	4.0	29.1	17.3	8.9	6.9	1,000	750	0.38	
Coal.....	400	17.9	0.5	0.4	11.7	46.7	0.0	17.4	5.4	550	980	1.5	
Oil.....	400	15.5	16.6	0.0	1.0	23.2	39.1	4.6	0.0	1,182	600	0.0	
Amalgam.....	500	3.0	17.0	0.0	5.3	37.4	12.0	25.0	0.3	937	4,470	3.0	
Coal.....	500	10.2	1.2	0.6	19.7	38.4	8.5	12.2	8.6	779	2,970	0.1	
Oil.....	500	0.6	39.6	0.4	0.5	29.3	24.1	2.9	2.6	1,353	5,300	2.6	
Amalgam.....	600	3.0	8.8	0.6	8.7	50.8	0.0	25.3	2.8	730	10,650	8.4	Continuous feed
Amalgam.....	600	3.3	13.6	0.6	7.5	49.4	0.0	23.9	1.7	794	5,550	3.6	Batch distillation
Coal.....	600	4.7	3.3	0.5	11.4	30.6	0.0	46.2	3.3	525	6,430	4.5	
Oil.....	600	1.3	31.0	0.5	1.8	46.3	10.8	5.0	2.8	1,167	16,900	11.1	
Amalgam.....	700	—	—	—	—	—	—	—	—	—	—	—	Gas samples uncertain
Coal.....	700	6.4	0.6	0.5	28.1	13.0	0.0	46.9	4.5	370	10,750	2.1	
Oil.....	700	0.4	23.2	0.5	0.5	63.6	2.0	8.3	1.5	1,056	19,320	7.0	
Amalgam.....	800	4.9	8.9	9.7	6.7	35.3	8.1	31.5	3.9	757	19,800	4.1	Continuous feed
Amalgam.....	800	4.7	6.1	0.0	7.5	52.9	5.4	36.9	3.4	654	3,400	20.2	Batch distillation
Coal.....	800	4.2	3.0	0.4	16.5	26.6	0.0	45.4	3.9	496	10,000	0.55	
Oil.....	800	2.1	2.2	0.0	1.6	63.7	0.0	28.2	2.3	710	20,050	2.1	

does coke-oven gas, as will presently be shown, and if it should ever prove practical to treat industrial gas for alcohol, this gas would offer attractive possibilities.

METHOD USED IN CARBONIZING TRENT AMALGAMS

The method used here to carbonize the amalgams differs from any now used for the commercial carbonization of coal. In ordinary practice, coal charges are dis-

Herrin, Ill., and an asphaltic-base fuel oil. An analysis of the coal is given in Table I, also the fractionation results for the oil. Table II gives the analyses of gases evolved from amalgam, coal and oil at temperatures 400, 500, 600, 700 and 800 deg. C., together with total yields of gas and light oils scrubbed from the gas. Results for the 700 deg. amalgam run are not reported, owing to the fact that precipitated carbon clogged the mains and rendered the gas samples taken of doubtful value.

In general, the oils give higher yields and richer gases; the amalgams give somewhat less gas of poorer quality; and the coals give the lowest yields and the poorest gas. It is an interesting fact that the run at 800 deg. C. (with continuous feed) gave almost as much

¹Bury, Ernest, "Ethylene as Alcohol From Coke-Oven Gas," *Gas Journal*, vol. 148, Dec. 30, 1919, p. 718.

²De Loisy, M. E., "Sur un procédé industriel de fabrication synthétique de l'alcool et de l'éther à partir des gaz de distillation de la houille," *Compt. rend.*, vol. 170, January, 1920, pp. 50-3.

³A paste consisting of approximately 2 parts finely pulverized coal and 1 part oil such as that obtained as a final product in the Trent process for cleaning coal. See Perrott, G. St. J., and Kinney, S. P., "The Use of Oil in Cleaning," *Chem. & Met.*, vol. 25, Aug. 3, 1921, p. 182.

gas for the amalgam as for the oil, and gave a gas of slightly better quality. At this temperature, it thus appears that Trent amalgam is just as good material for making commercial oil gas as the oil itself. The amalgam would of course be the cheaper, and further, it will be noted that under these conditions more oil was scrubbed from the amalgam gas than from the oil gas. Of course if a rich oil gas is wanted, the best procedure is to crack the straight oil at a lower temperature.

The percentages of oxygen-containing gases for the coals and amalgams are considered somewhat high. This is due partly to the method of feeding the retort and partly to the fact that the coal used was of high oxygen content. As for the first cause, the charge fed was finely divided, and must have carried into the retort a fair amount of adsorbed air.

UNSATURATED GASES

The percentages of unsaturated gases are uniformly higher for the oil except with the run at 800 deg. C., where the amalgam gives the highest percentages. The coals give the lowest percentages of unsaturated gases, but slightly higher, perhaps, than would be obtained by commercial methods of carbonization. The amounts of these bodies found for the amalgams are intermediate between those for the oil and coal. Unsaturated gas is reported here as ethylene (C_2H_4), and it is probable that 95 per cent of it actually was ethylene. Especially is this true when it is considered that the gas had passed a charcoal scrubber, which would have a tendency to remove heavier gases.

YIELDS OF UNSATURATED GASES FROM AMALGAMS

Table III gives the yields of unsaturated gases from amalgams at the corresponding temperatures of distillation and their equivalents in alcohol, assuming complete recovery. Figs. 1 and 2 show the data graphically. As a basis of comparison of yields, we may take Bury's¹ figure of 1.6 gal. of absolute alcohol per ton of coal charged in byproduct ovens. Assuming a 50 per cent recovery, this would mean a possible yield of only 3.2 gal. of absolute alcohol per ton of coal from coke-oven

¹Work cited.

TABLE III—YIELDS AND ALCOHOL EQUIVALENTS OF UNSATURATED GASES FROM AMALGAMS

Temp., Deg. C.	C_2H_4 , Per Cent	Total Gas, Cu.Ft.	C_2H_4 , Cu.Ft.	Alcohol Equiv., Gal. Per Ton
400	25.4	750	172	3.1
500	17.0	4,400	760	13.8
600	6.8	10,850	955	17.3
800	8.9	19,600	1,760	32.0

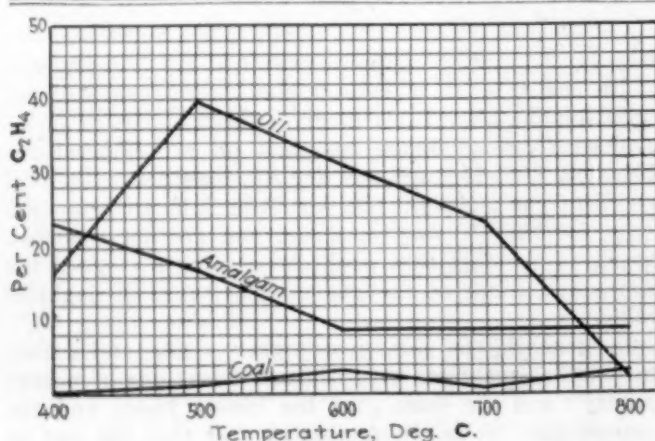


FIG. 1

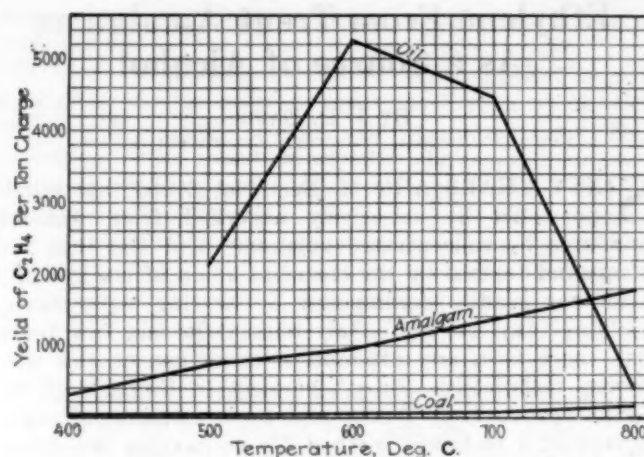


FIG. 2

gas, whereas from Trent gas there is possibly from 3 to 32 gal. per ton of amalgam charged. It would thus seem that Trent gas is ideal (second only to oil gas) for the application of an alcohol recovery process.

RECOVERY OF ETHYLENE AS ALCOHOL

So far it has not been possible to recover from coke-oven gas more than 50 per cent of ethylene contained as alcohol, but it would undoubtedly be possible to improve this figure considerably by research. The problem offers possibilities, particularly in connection with the rich Trent gas. For example, De Loisy² found that he could increase considerably the speed of absorption of ethylene by sulphuric acid through the use of catalytic agents, and thereby increase the recovery of alcohol.

LOSS OF HEATING VALUE THROUGH REMOVAL OF ETHYLENE FROM GASES

Table IV shows that the loss of heating value suffered by Trent amalgam gases on removal of the ethylene is not an important consideration. They are rich gases to start with, and the removal of ethylene, although that gas has a high heating value, does not bring their heating value below that of the best industrial gases.

TABLE IV—EFFECT OF REMOVAL OF ETHYLENE ON THE HEATING VALUES OF TRENT AMALGAM GASES

Distillation Temp., Deg. C.	B.t.u. Per Cu.Ft. Raw Gas	B.t.u. Per Cu.Ft. Scrubbed Gas
400	1,000	798
500	936	795
600	726	639
800	757	671

It may be stated further that the ethylene in the composite gas has a market value much below that which it would have as pure gas. For example (see Table III), a 600 deg. distillation will yield 10,850 cu.ft. of composite gas, 955 cu.ft. of which is ethylene. The ethylene, if recovered commercially pure, would be worth 1 cent per cubic foot, or \$9.55, whereas all the gas (at 50 cents per 1,000) would be worth about \$5.40.

CONCLUSIONS

1. Trent amalgams yield gases intermediate between those from coal and oil in respect to both quantity and quality.
2. The high percentage of unsaturated gases from Trent amalgams offers a promising field for research.

Reports of Investigations,
U. S. Bureau of Mines.

²Loc. cit.

Book Reviews

METHODS OF THE CHEMISTS OF THE UNITED STATES STEEL CORPORATION FOR THE SAMPLING AND ANALYSIS OF PIG IRON. 40 pages, paper covers. Published by the Carnegie Steel Co., Bureau of Instruction, Pittsburgh, Pa. Price \$1. cash with order.

This is a revision of a similar pamphlet published 10 years ago for use of the chemists of constituent companies of the United States Steel Corporation. Such a manual is evidently most useful in enabling chemists in distant laboratories to reach comparable results on a shipment of iron—even though this iron is sent from one subsidiary to another—from the vest pocket to the hip pocket, as it were. The present booklet is the work of W. B. N. Hawk of Lorain, William Brady of South Chicago, and H. E. Campbell of Clairton.

Accurate and accepted methods of analysis are also essential to prevent disputes with outside buyers. For this reason the American Society for Testing Materials has adopted many standards for sampling and chemical analysis. Both publications agree, for instance, that Drown's method for silicon is to be used—the Carnegie pamphlet appears to describe the manipulations which would be adopted in repetitive routine work.

It is advised that molten iron be poured into a chill mold. Granulation by water cools too rapidly, the sample cannot be used for combined or graphitic carbon, and sulphur (by evolution) is always low. Sand-cast samples, on the other hand, are likely to be contaminated by molding sand. While it is recognized that volumetric or evolution methods for sulphur do not give exact figures (two gravimetric methods are described for accurate work) it is the only one known "which can be made within the time limits fixed upon the laboratory," and in careful hands and on steady production gives very good figures for control.

Combustion methods and apparatus for total carbon are given in great detail. Analysis for titanium and copper are added to those other elements ordinarily determined. E. E. THUM.

CLAY PRODUCTS CYCLOPEDIA. First annual edition, 1922. 252 pages, illustrated. Published by Industrial Publications, Inc., 407 South Dearborn St., Chicago, Ill. Price, \$3.

It is the aim of this book to present in readily available form information and data pertaining to all phases of the clay products industry. In an industry with so many ramifications this represents no small undertaking, and the editors are to be congratulated upon the success of their labors. In what is termed the definition section, covering 121 pages, will be found condensed information regarding more than 700 materials, processes or types of equipment. The arrangement is alphabetical and each item is numbered.

Many items are supplemented and treated more fully in a statistical section of 75 pages. While much of the material has been compiled from various sources, there is also a great deal which is original. As the editors are in constant touch with the industry through their publication *Brick and Clay Record*, the correctness of such material is assured.

Alphabetical arrangement always presents the disadvantage of scattering items which may be closely related in considering a given subject or phase of a subject. This difficulty has been overcome in the "Departmental Index

of Plant Equipment," which will be found extremely valuable in locating related information. The field is divided into general, pottery, and heavy clay products and under appropriate subheads will be found the numbers of all items to be consulted.

The remainder of the volume is devoted to a catalog section giving informative data regarding equipment and materials manufactured by different firms supplying the industry.

Because of its unusual reference value, this book should be indispensable to everyone connected with or interested in the manufacture of clay products. ALAN G. WIKOFF.

Recent Chemical & Metallurgical Patents

American Patents

Issued Nov. 14, 1922

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for Chem. & Met. readers. They will be studied later by Chem. & Met.'s staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

- 1,435,211—Electric Furnace.
- 1,435,219—Coking Process.
- 1,435,361—Coke-Oven Decarbonization.
- 1,435,382—Sorting Materials.
- 1,435,471—Hydrogen Sulphide Process.
- 1,435,505—Recovery of Metals From Fumes.
- 1,435,506—Recovery of Metals From Fumes.
- 1,435,524—Treatment of Salt Mixtures.
- 1,435,650—Preparation of Cellulose Solutions.
- 1,435,652—Cracking Hydrocarbons.
- 1,435,727—Method of Concentrating Brine.
- 1,435,742—Production of Refractory Alloys.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Barium Chloride From Black Ash Waste—J. H. McMahon has assigned this patent to the Mathieson Alkali Works, Inc. The process consists essentially of producing soluble barium compounds from the residue left after the leaching of black ash with water. As the process stands now, barium sulphate (and other barium ores as barytes) is treated with coal and reduced at a high temperature, from which process barium sulphide or black ash results. This black ash is leached free from barium sulphide and the resulting residue contains a great deal of barium carbonate. The residue or exhausted black ash is well ground and reduced to a finely divided condition,

then heated with a solution of ammonium chloride, from which a reversible reaction results in the partial production of barium chloride. This reaction would soon reach a definite end point due to the formation of ammonium carbonate along with the barium chloride, which compound would react to the original barium carbonate and ammonium chloride. To get around this difficulty, the solution is either agitated with air or boiled vigorously, which gets rid of the ammonium carbonate, and the process then goes to completion with the formation of barium chloride.

The mineral can either be treated according to the black ash process first, or it may be treated with ammonium chloride first and the remaining sulphate reduced with black ash. It is stated that the reaction with ammonium chloride will be 90 per cent completed after an interval of about 3 hours. The barium chloride thus formed is in solution and may be recovered by filtering, evaporating or crystallizing in the usual manner. (1,428,646. Sept. 12, 1922.)

The Manufacture of Acetic Anhydride—H. W. Matheson and G. E. Grattan have assigned to the Shawinigan Laboratories, Ltd., of Montreal, the following processes for making acetic anhydride. Glacial acetic acid is heated from 60 to 200 deg. C., according to the pressure under which the reaction takes place, and is violently agitated until the acetylene gas, which is blown into the liquid, is completely absorbed. Acetic anhydride is formed when these two materials react in the presence of a small quantity of finely divided mercury salt. Five hundred parts of pure acetic acid from 96 to 100 per cent are treated with 25 parts of mercury oxide and to this are added 12 to 13 parts of concentrated sulphuric acid, in order to precipitate mercuric sulphate. Acetylene gas is then passed into the reaction kettle under a pressure of 40 lb. per sq.in., above atmosphere pressure.

The temperature is permitted to rise to 130 deg. At the end of about 2 hours a mixture of acetic anhydride, together with ethylidene diacetate and a small amount of acetaldehyde, will be left behind. The reaction mixture must be agitated during the absorption. Mercury salts are filtered out and the product purified by distillation. (1,425,500. Aug. 8, 1922.)

Coke-Oven Construction—The horizontal transfer flue common to all coke ovens of the vertical flue regenerator type has long been considered a source of structural weakness. To overcome this drawback the type of construction shown in the accompanying figures has been developed. The principle is embodied in constructing the side walls of horizontal flue of what are called "notched brick." These brick are made with the ends of rectangular section, while the central portion is cut or notched until it has only a fraction of the cross-sectional area of the ends. In practice, brick of this type are laid so that the rectangular ends form the walls of the horizontal transfer flue, while the notched or cut-down parts form struts or braces between these two walls, thus serving to strengthen the structure.

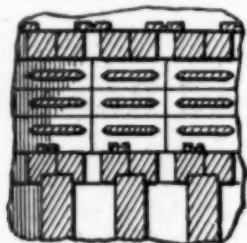


FIG. 1—LONGITUDINAL SECTION THROUGH HORIZONTAL FLUE

Fig. 1 shows a type of construction where every brick used is of this type. Fig. 2 shows an alternate type of construction which presents less resistance to gas flow but is not structurally as strong. (1,430,588. Arthur Roberts, assignor to the Chicago Trust Co. Oct. 3, 1922.)

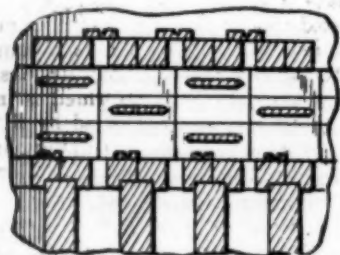


FIG. 2—ALTERNATE CONSTRUCTION

Fig. 1 shows a type of construction where every brick used is of this type. Fig. 2 shows an alternate type of construction which presents less resistance to gas flow but is not structurally as strong. (1,430,588. Arthur Roberts, assignor to the Chicago Trust Co. Oct. 3, 1922.)

Drying Apparatus Control—In the operation of the common type of drying apparatus which depends on the circulation of heated air for its drying effect, it is often desirable to maintain a predetermined humidity by controlling the amount of air which is re-circulated through the heating unit in relation to the amount of fresh air which is drawn in from the outside atmosphere. In this invention this is accomplished by locating in the air flues—on one side

or the other of the fresh air inlet—a thermostatic diaphragm motor which operates a series of dampers regulating the openings in the various air passages. (1,431,145-1,431,146. J. E. Bolling, assignor to Drying Systems, Inc. Oct. 10, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Concentrating Coal—A process of separating coal particles of linear dimensions between 0.1 and 0.5 in. from shale or other gangue consists in submitting crude crushed or screened coal to treatment to coat the coal particles with a film of oil, and submitting the treated material to concentration by film flotation or subaeration flotation. The oiling may be effected by agitating a pulp of coal and water with an oil such as paraffine oil or fuel oil, or by immersing the coal in such an oil and then draining it. The coal may be first screened to separate out the particles of the size referred to, or the whole of the crushed coal may be treated together. In some cases, a frothing agent such as cresol may be added. (Br. Pat. 183,504. F. B. Jones and Minerals Separation, Ltd., London. Sept. 20, 1922.)

Artificial Silks—In the manufacture of artificial silk, films, etc., from viscose, an aqueous extract of certain plants is added either to the precipitating bath containing sulphuric acid and sulphates, or to the viscose itself. Salts of ammonia, triethylamine, pyridine, etc., may also be added to the bath. The materials used for making this extract may be the wood, stalks, leaves, needles, roots or fruits, particularly the needles, of conifers, and such roots or fruits as give mucilaginous extracts, such as mallow roots and linseed; and the extracting mediums may be water, solutions of acids or of substances having an acid reaction, or solutions having an alkaline reaction. The water extracts are obtained by boiling the material to be extracted with water under pressure, acidifying the extract, heating preferably to boiling point, filtering, and if necessary, concentrating preferably *in vacuo*; the salts necessary in the precipitating bath may be added to water during the extraction process, or they may be added to the extract. A similar procedure is adopted in the case of acid alkaline extractions; a suitable acid extracting medium is 5 per cent sulphuric acid, and as an alkaline extracting medium, solutions of sodium hydrate, soda or ammonia may be employed; "the dyes precipitated in the manufacture of viscose silk and soda-cellulose may also be used." The extracts may be rendered colorless by the addition of bleaching agents such as hydrosulphites, hydrogen peroxide or sodium peroxide or perborate, either during or preferably after the extraction process. From the needles of conifers is obtained "pine-

needle extract," which extract contains terpene-like substances of particular value in the precipitation process; other extracts deficient in these substances may be improved by the addition of turpentine, turpentine oil, "pinon," dipentene, and the product obtained by reacting with acids on pinene, pinol, etc. (Br. Pat. 183,476; not yet accepted. Naamlooze Vennootschap Hollandsche Kunstzijde Industrie, Breda, Holland. Sept. 20, 1922.)

Synthetic Resins—Synthetic resins are formed by the direct action of acetylene on phenol or its homologs in the presence of acid and a mercury salt. Acetylene, preferably in excess, is passed into a mixture of the phenolic body with a little acid, such as sulphuric acid, or an acid salt to which mercurous or mercuric oxide or sulphate has been added; the temperature is preferably maintained at 50 to 120 deg. C.; increased pressure may be employed; a solvent for the phenol—for example, glacial acetic acid, an alcohol or acetone—may be present. Examples are given in which phenol and cresol are the starting materials, the resulting products being finally rendered infusible and insoluble by any method, such as treatment under heat and pressure with hexamethylenetetramine. (Br. Pat. 183,830; not yet accepted. Shawinigan Laboratories, Ltd., Montreal. Sept. 20, 1922.)

Wire Drawing—Dies for drawing tungsten wire, etc., are made from an alloy of tungsten and cobalt. The alloy may consist of 75 to 95 parts of tungsten to 25 to 5 parts of cobalt. The dies are made by producing the alloy by a thermo-aluminic process and then drilling and polishing. The alloy made may be sufficient to form a single die or a number of dies, in which case it is first sawed into pieces. In order to make the alloy, tungstic acid and cobalt oxide are first freed from moisture by heating at 400 deg. C. and are then mixed with fine-grained aluminum and fused in the ordinary way. (Br. Pat. 183,807; not yet accepted. Naamlooze Vennootschap Philips' Gloeilampenfabrieken, Eindhoven, Holland. Sept. 20, 1922.)

Soap—Soap, in a white and inodorous condition, is produced from soaps made from refined or unrefined oils, fats and fatty acids, or waste products of oil and fat manufacture, or from soapstocks obtained in deacidifying fats and oils, by spreading aqueous solutions of these materials over surfaces such as plates or rollers heated, for example, to 90 to 150 deg. C. By treating a thin film of soap at 100 deg. C., a dry product is obtained which on cooling takes the form of flakes. By using a lower temperature and a thicker layer of the solution, the amount of residual moisture can be regulated, and soap in pasty condition, suitable for making cakes or bars, is obtained. (Br. Pat. 183,837; not yet accepted. B. J. A. Nijdam, Wageningen, Holland. Sept. 20, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

More Tariff Rate Change Applications

Oxalic Acid Duty May Be Changed—Hearings to Begin in Two Weeks

Applications are continuing to pour in upon the tariff commission for changes in rates in the new tariff bill. Members of the commission declare that since the bill went into effect, only a few weeks ago, more than eighty applications have been filed for increases in rates for the protection of domestic manufacturers, reductions in rates for the benefit of importers, and for changes in classifications of commodities to lessen the burden of present rates on particular commodities.

APPLICATIONS ON CHEMICAL RATES NUMEROUS

The principal commodities represented by the applications filed to date, it was said, are chemicals and wool. In view of the comparatively large number of applications filed for changes in rates and the commodities agitating for these changes, officials do not consider the number of petitions filed as alarming.

OXALIC ACID RATE

The Advisory Board, supported by the report of the experts on chemicals, has filed data with the commissioners indicating that there is such a great difference in the comparative costs of oxalic acid in the United States and abroad and that a hearing well might be called to consider an increase in the rate on this chemical. A similar report has been filed on another chemical, which has not been identified.

It was learned upon good authority that the majority of the applications for changes in tariff rates, under the flexible provisions of the Fordney-McCumber act, represent chemicals and agricultural products.

HEARINGS IN TWO WEEKS

The commission is having its commodity experts look carefully into the merits of the contentions before taking any definite action in the nature of open hearings, but officials are hopeful that the first hearings may be begun within the next two or three weeks, at which the commission may begin to take arguments on the accumulation of applications and decide the merits of the petitions.

Chairman Marvin of the commission is understood to be anxious to begin the hearings as soon as possible, and has urged experts of the commission

to make every effort to this end. The difficulty met in obtaining the services of experts to investigate the applications as filed has slowed up the administration of the tariff measure and may yet delay the proposed hearings until the tariff machinery has been perfected.

Says Ford Will Get Muscle Shoals

That the disposal of Muscle Shoals to Henry Ford is but a matter of time was the announcement made by A. G. Patterson, president of the Public Service Commission, before the national convention of railway and utilities commissioners in Detroit last week.

When Muscle Shoals is completed, some of the vast amount of power developed there will be used for public utilities and, in that way, will come under the direct regulation of the commission.

"Never before have we been so certain that Congress will lease Muscle Shoals to Mr. Ford as we are today," said Mr. Patterson. "Muscle Shoals will go to Mr. Ford because no other party in the country has made, nor can make, an offer that compares with his. His nearest competitor is the Alabama Power Co., which is controlled by Wall Street capitalists. The South will never consent to have the destiny of its industries handed over to Wall Street control. The South trusts Mr. Ford because he does business on a conservative basis."

Physical Chemists Chosen as Editors of "Journal"

Announcement has been made of the selection of a board of editors for the *Journal of Physical Chemistry* to take over the burden of issuing that publication from Wilder D. Bancroft, of Cornell University, who has borne the entire responsibility of it for the past 18 years. The journal will be published in the future under the auspices of three societies, the Chemical Society of London, the Faraday Society and the American Chemical Society.

The following physical chemists have been named editors: By the Chemical Society of London, Professors T. M. Lowry, J. W. McBain and James C. Philip; by the Faraday Society, London, Prof. F. G. Donnan; by the American Chemical Society, Dr. A. L. Day, Prof. G. A. Hulett, Dr. Irving Langmuir and Prof. W. Lash Miller. Professor Miller is a Canadian member of the American society.

Trade Board Protests Alcohol Ruling

Urge Separation of Prohibition Enforcement and Industrial Alcohol Revenue Collection

Vigorous protest against the methods of the Treasury Department with regard to the legitimate commercial user of alcohol, who finds it almost impossible to keep abreast of the continuous stream of rulings emanating from Washington on the use of this chemical, was voiced at a meeting of the drug and chemical section of the New York Board of Trade and Transportation in New York, last week.

In particular, the recent Treasury decision 3398 was condemned, since it is claimed that it is "an apparent attempt, without authority of law, to collect 25 per cent of the face value of a bond without resort to legal action, in addition to the penalties already provided for violations in the prohibition act itself."

Approval was given at the meeting to the protest of the committee on prohibition law enforcement and legislation of the board in this matter, which was stated in a letter to the Secretary of the Treasury, signed by Frank G. Starr, of Sharp & Doehme, chairman.

URGE SEPARATE ENFORCEMENT

The committee also recommended a separation of the functions of the supervision of alcohol for industrial and other non-beverage purposes from the policing of violations of the prohibition law and urged the Commissioner of Internal Revenue to appoint a deputy commissioner to take over the industrial alcohol and chemical division of the prohibition unit.

University of Washington Offers Broad Course in Ceramics

The University of Washington, Seattle, Wash., announces the twenty-seventh annual winter mining session, to continue from Jan. 4 to March 21, 1923. No previous training is required for entrance. The expenses of the courses consist of laboratory deposits for material actually used and a university fee of \$20.

The course in ceramics includes the study of clay testing, lime, plaster, cement, brick, stoneware, whiteware, refractories, glaze studies, clay technology and terra cotta manufacture. A postal card to the College of Mines, Seattle, will bring full details.

Agricultural Chemists Adopt Standard Methods

Value of Chemistry in Agriculture and Biology Stressed—Duplication of Scientific Work

During the deliberations of the Association of Agricultural Chemists in Washington last week, F. P. Veitch, retiring president of the association, made a plea for the elimination of waste in scientific work. In addition, he emphasized the importance which chemistry is playing in agriculture and in industry. In the course of these remarks Dr. Veitch, among other things, said:

"There are so many concrete things worth doing that the tendency to needless expansion and duplication is difficult to foresee or to check. Both are so wasteful of the people's funds, of time and effort that they should be guarded against at all times.

"Why has it been deemed necessary or even desirable for other organizations to repeat and duplicate much of the work done by this association? Why must three or perhaps more other organizations investigate the determination of the iodine numbers of oils? Why is it necessary for these organizations to do more than adopt these methods which are the outcome of many years of careful, thorough and impartial co-operative effort? What can be done to stop this waste of time and effort, and the doubt and conflict that result from the use of different methods?"

CHEMISTRY IN AGRICULTURE

"Years ago a distinguished member of this association remarked that no line of agricultural work progresses far before it is necessary to call in the chemist. This should be a more generally recognized fact. Take chemistry out of biology and nutrition and little but a name is left. Forget and abandon today's chemical knowledge in agriculture and industry, and civilization drops back two thousand years, because even two thousand years ago they were recognized as the rudiments of applied chemistry. In peace and in war it plays its major part."

ADOPT ANALYTICAL METHODS

With regard to boric acid in fertilizers, the association approved the following recommendation:

That as boron compounds not soluble in water, but soluble in weak acids, appear to be as injurious to plants as the water-soluble compounds and since the Bartlett distillation method as now carried out determines the boron in such compounds, it is recommended that it be adopted as an official method in its present form to determine boron in mixed fertilizers and fertilizer materials.

NITROGEN DETERMINATION

With regard to nitrogen the following recommendations were approved:

That the referee for 1923 be instructed to study the DeVarda method as applied to the nitrate of commerce.

That the Moore method for nitrates be studied with collaborators next year.

That the referee on nitrogen for 1923 be instructed to study the use of sodium thiosulphate as a substitute for sodium or potassium sulphide in pre-

cipitating mercury in the Kjeldahl method.

The association authorized the appointment of a referee to consider the determination of active acidity of hydrogen-ion concentration for agricultural chemical products.

FERTILIZER ANALYSIS METHODS

With regard to potash, a recommendation to the effect that the investigation of the centrifugal method by Sherrill be discontinued was approved. The general referee on fertilizers was instructed to study the literature with regard to the use of alcohol, stronger than 80 per cent, for washing the potash precipitate with a view to ascertaining if collaborative investigation of the question is desirable.

A recommendation was approved to the effect that the determination of insoluble phosphoric acid in precipitated phosphates be carried out according to the present official method for the determination of insoluble phosphoric acid in fertilizers, with the exception that a 1-gram charge be employed.

New York State Industrial Conference Considers Elimination of Waste in Industry

ELIMINATION of waste in industry was the watchword at the sixth annual New York State Industrial Conference which was held in Buffalo, N. Y., Nov. 21 to 24. Governor Miller, who had been expected to attend the opening session, wrote a letter that was read to the delegates.

"The limitation of waste in government is of equally great importance to the man of business and industry," the Governor wrote. "Industry and business, therefore, do well to meet and take counsel with government. The contracts made, the points of view acquired, cannot fail to be of service to the state, to business and to industry."

WELFARE OF WORKERS

Commissioner Henry D. Sayre reviewed the progress made in reducing the number of industrial accidents and said that with continued co-operation of industry itself further progress would be made, not only in reducing accidents, but in restoring injured to their full powers.

"The worker does not want to be coddled," said Mr. Sayre. "He does not want to be patronized. But he does want and is entitled to be protected from the effects of overfatigue and from the dull monotony of a constant repetitive process."

William D. Baldwin, of the Otis Elevator Co., spoke of better relations that exist between employers and employees now as compared with former times, for which, he said, much credit was due to workmen's compensation laws.

WASTEFUL INDUSTRIAL HABITS

Wasteful industrial habits are costing the nation billions of dollars annually, L. W. Wallace of New York City, executive secretary of the Federated American Engineering Societies, de-

Swedish Match Company Increases Capitalization

It is now definitely announced that the board of Svenska Taendsticks Aktiebolaget (Swedish Match Co.) has decided to propose that the present share capital be raised from 45,000,000 to 90,000,000 kroner. The new shares are to be issued at the rate of 120 per cent, thus bringing the total increase up to 54,000,000 kroner.

As the board of directors considers this amount too large for the Swedish market, an agreement has been entered into with a British company to place 40 per cent of the shares issued in England. It is expected that the company's shares will be quoted on the London Stock Exchange.

The new capital is to be used for the purpose of building match factories abroad, especially in India, this policy having proved advantageous. The company's exports of matches during the past few years have greatly increased and are now above the pre-war figure.

clared in addressing the convention. Lost production caused by ill health, physical defects and industrial accidents was a prolific source of waste, asserted Mr. Wallace, who said that the "42,000,000 men and women gainfully employed in the United States probably lose on an average more than 60 days yearly from illness or disability, including non-industrial accidents, or a total of more than 252,000,000 days."

The 12-hour day and the 7-day week were classed as wasteful industrial habits by Mr. Wallace, who cited the findings of the committee on work-periods in continuous industry of the Federated American Engineering Societies and the observations and experiences of John D. Rockefeller, Jr.

MANAGEMENT AT FAULT

Mr. Wallace, held management responsible for conditions which slowed down production and produced increased cost, hardships and labor unrest. Cancellation of orders and the return of goods he characterized as vicious practices hindering stabilization. He commended Mr. Hoover's plan for an authoritative national information agency to aid managers of industry and commerce. High labor turnover he called another indictment of management. He advocated systematic and permanent study of the unemployment problem, ascribing to intermittent employment great waste. Labor difficulties in the clothing and building industries could be greatly reduced, he said, by the adoption of a more uniform production schedule.

Both management and labor, he charged, were guilty at times of criminal restriction of production, individually and collectively.

Paint Company Restrained on Charge of Misbranding of Goods

Charging methods of unfair competition in the misbranding of goods, the Federal Trade Commission has issued a formal complaint against John McQuade & Co., Inc., of Brooklyn, N. Y.

The concern is a manufacturer and seller of paints and similar products and is charged in the complaint with using on containers of certain of its products words and combinations of words which are not true descriptions of the contents of such containers. Among the words so used on labels, it is alleged, are the following: "French White Zinc," "Vieille Montagne Co., Paris," "Green Seal," "White Zinc" and "American White Lead."

Paint products so labeled, it is further charged, have definite meanings to the trade and others, in respective instances as follows: the words "Vieille Montagne" denote to the trade and to the purchasing public a zinc oxide commercially pure and one manufactured and sold by the Société des Mines et Fonderies de Zinc de la Vieille Montagne; that the term "Green Seal," when used to describe "White Zinc," signifies to the trade and to the purchasing public a high grade of white zinc; "White Lead," when used in labels placed upon commercial containers of pigments, signifies to the trade and to the purchasing public pigments composed wholly of commercially pure basic lead carbonate or basic lead sulphate. The commission's complaint alleges that the branding and labeling used by respondent is misleading and deceives the trade and the purchasing public because its goods so labeled do not conform with the above definitions.

Manufacturing Chemists' Association Protests Rate on Private Tank Cars

That the railroads should pay more for the use of privately owned tank cars is the contention set forth in a complaint filed with the American Railroad Association by the Manufacturing Chemists' Association. This action is taken largely in the interest of acid manufacturers. The American Petroleum Institute is taking similar steps with reference to privately owned oil tank cars.

Fertilizer Men Consider Protest on Freight Rates

Whether or not an attempt will be made to obtain an adjustment of the whole framework of fertilizer freight rates will be decided at a meeting of the traffic committee of the National Fertilizer Association which will be held in Cincinnati on Dec. 7. The fertilizer association contends that rates on fertilizers are higher than those charged on comparable commodities. It also is contended that lower rates will stimulate shipments and increase the profits of the carriers on this traffic.

Rarer Metals Symposium to Feature A.E.S. Meeting

Experts in Production and Applications of These Elements to Speak—Session on Electrode Potential

The growing importance of the so-called "rarer metals" is recognized by the American Electrochemical Society, which is planning an extended symposium on the subject at its forty-third annual meeting next spring. The convention will be held in New York, May 3, 4 and 5, 1923, headquarters being at the Hotel Commodore.

The symposium on "The Production and Application of the Rarer Metals" will occupy an entire day. Arrangements for this session are in charge of F. M. Becket of the Electrometallurgical Corporation, New York City. There will be papers on vanadium, tungsten, cobalt, molybdenum, zirconium, cerium, uranium, tantalum, calcium, magnesium and others.

Among the speakers will be: H. N. McCoy, president of the Carnotite Reduction Co. of Chicago; H. W. Gillett, of the Bureau of Mines, Ithaca, N. Y.; B. D. Saklatwalla, of the Vanadium Corporation; F. E. Carter, of the Baker Platinum Works, Newark, N. J.; H. S. Cooper (paper on zirconium metal); J. A. Holladay, of the Electrometallurgical Corporation (paper on analyses); M. A. Hunter, of the Rensselaer Polytechnic Institute, Troy, N. Y. (two papers; one on titanium); Mr. Clancy (paper on alloys as catalyzers); Mr. Cutter, of the Climax Molybdenum Co.; Russell Lowe, Barro Metal Corporation (paper on barro metal); Colin G. Fink, secretary of the society (paper on tungsten); C. E. Minor, Aravaipo Leasing Co., Klondyke, Graham County, Ariz.; W. R. Whitney, director of research laboratory, General Electric Co., Schenectady, N. Y.

Another session will be devoted to a discussion of "Electrode Potentials" headed by William G. Horsch, of the Chile Exploration Co., New York. The papers will cover studies on reversible electromotive force, overvoltage, ion activities and dissociations, electro-titration and p_H determinations.

Heavy Fire Loss at Plant of Duquesne Steel Co.

The plant of the Duquesne Steel Foundry Co. at Kendall, Pa., was threatened with destruction by a fire on Nov. 20, which destroyed one of the main shops of the plant. Shortly before midnight companies from five adjoining villages assisting the Kendall department apparently had the conflagration under control.

A preliminary estimate of the loss, made by an official of the company, was \$350,000. The cause has not been ascertained, but the flames spread with great rapidity and threatened two oil tanks in the heart of the plant, which covers twenty acres. The company manufactures steel castings and locomotive cranes.

Photography to Feature Joint Meeting of Societies in New York

The monthly meeting of the Society of Chemical Industry, to be held at Rumford Hall in the Chemists' Club, 52 East 41st St., New York, has been postponed from Friday, Dec. 1, to Friday, Dec. 15. The evening will be devoted to papers dealing with some of the chemical or physical aspects of photographic science, with special reference to the uses of photography and motion pictures in the industries. A paper dealing with the last-named aspect—the application of photography and motion pictures to industry—by Dr. A. B. Hitchins, director of the research laboratory of the Ansco Co., Binghamton, N. Y., will open the proceedings, and this will be followed by an address on "Some Chemical Aspects of Photographic Science," by Dr. F. F. Renwick, director of the Redpath laboratory of E. I. du Pont de Nemours & Co., Parlin, N. J. The third paper will be by Dr. Herbert E. Ives, research engineer of the Western Electric Co., New York, who is to take for his subject "Color Measurement as Utilized in Color Photography." This paper will be illustrated by lantern slides.

The members of the Technical Photographic and Microscopical Society are invited to attend this meeting, which has been planned for their benefit as well as for the members of the American Section of the Society of Chemical Industry.

New Surgical Suture Invented in Wisconsin University

A skin suture for use in surgical operations that leaves no unsightly scars and combines all of the advantages of horsehair with none of its disadvantages has been recently invented by Prof. Louis Kahlenberg of the chemistry department of the University of Wisconsin and has come to be extensively used by surgeons in America, Europe and the Philippine Islands. This new suture, called "equisetene," is made by chemically treating silk so that tissue cells cannot penetrate the meshes of the silk. The treatment overcomes the disadvantages which surgeons had found in silk as a suture, and makes a smoother, more uniform material for use in surgical operations, it is said.

First Soda-Pulp Mill in Canada Planned by Smith Company

After a meeting of the directors of the Howard Smith Paper Mills in Montreal, Canada, it was announced that the company would proceed shortly to erect a plant for the manufacture of bleached soda pulp. So far Canada has imported what it needed.

The soda pulp will be used for mixing with sulphite pulp to go into the manufacture of certain grades of paper, the varieties produced by the company having grown to a marked extent in the past couple of years.

Domestic Tungsten Industry Slack

In Spite of Price Rise Due to Tariff, American Producers Cannot Operate Profitably

Due in part to natural economic pressure but largely to imposition of a tariff rate equivalent to \$7.14 per unit, the price of tungsten has steadily risen in the United States from quotations of \$1.85 to \$2 per unit as late as last March to around \$8 per unit. Even at the increased price, domestic mines remain idle, for the second year since 1899. Domestic production ceased after 1920, when the average price dropped to \$7.86 per unit from the \$18.02 average of 1919, which latter was the lowest average price over a course of years.

Despite the fact that reports to the Geological Survey indicate that there is 2 to 3 years' supply of tungsten in this country, there appears to be little prospect of a break in the market, as the supply is held in strong hands, willing to sell it only at favorable prices. Some steel makers are reported to have only a short supply remaining, indicating that demand will be stimulated before long.

DOMESTIC INDUSTRY CANNOT COMPETE

These factors favoring a price increase are offset, however, so far as domestic mining is concerned, by a study of figures compiled by Frank L. Hess, in charge of the rare minerals section of the Geological Survey, in a report covering 1921, which show that United States production of tungsten in 1918 was 5,061 short tons with an average price of \$23.24 per unit and dwindled to 327 short tons in 1919, with an average price of \$18.02; 216 short tons in 1920, with an average price of \$7.86, and disappeared entirely after that year with further and drastic price declines. In 1915 the average price per unit was \$29.30; in 1916, \$33.98; in 1917, \$18.40. Comparing the production table with the price table, it would appear that domestic mines do not find it profitable to produce tungsten when the price is below \$20 per unit, and it is a long climb from the present range of \$8 per unit to \$20.

Most of the tungsten now on hand in this country came from China, where military operations have compelled continued working of the placer mines even at the very low price of \$1.85 to \$2 per unit, landed cost, which was paid here for some months. Although the price has risen to approximately \$8 in the United States, Chinese tungsten still is being sold in England at around \$3 per unit.

The new tariff rate is approximately four times the price at which tungsten was being bought here last spring. The old tariff act did not impose a duty on tungsten imports.

VANADIUM SITUATION

The vanadium situation in the United States also is interesting. Produced here as a byproduct of radium, the output has ceased because of the radium

market conditions. Imports, which have been principally from Peru, also have practically ceased. There is a supply in this country, however, equal to 2 to 3 years' normal demand for the product. The Ford Motor Co., which was the largest consumer of vanadium in its steel, no longer uses this alloy.

Corn Products Co. Called Monopoly

Charged With Price Fixing by Federal Trade Commission—President Denies Charge

Declaring that the Corn Products Refining Company, of New York, "makes the market," and through the medium of guarantees against price declines in table sirups has eliminated the competition of smaller companies, the Federal Trade Commission has issued a formal complaint against the company, which has a capitalization of \$80,000,000.

In an extended statement, the Federal Trade Board explains that through the operation of the price guarantee system the Corn Products Refining Company has been able to force other competitors to lose their customers through lack of comparable resources.

MISINFORMED, SAYS OFFICIAL

E. T. Bedford, president of the company, and Frank H. Hall, counsel for the company, have issued statements declaring that the charge has evidently been filed on misinformation of the facts existing in the table sirup and glucose trade.

"Guarantee against price declines is given by practically all large manufacturers who distribute their advertised package goods under their own label through the wholesale grocer," declared President Bedford. "It prevents speculation and effects uninterrupted distribution, resulting in economies in both manufacturing and cost of transportation, as well as the cost of selling, all of which are in the best interest of the ultimate consumer, who, by reason of the guaranteed price, gets a lower price and the immediate benefit of any decline in price."

DENIES PRICE CONTROL

"The Corn Products Refining Company controls neither the price of glucose nor of table sirups," said Mr. Hall. "The markets for both of these products are highly competitive. While it is true that the company has a larger capacity for producing glucose than any single one of its competitors, nevertheless the combined output of the competitors is considerably larger than that of the refining company. All of these competitors are substantial and aggressive."

LIVELY COMPETITION

"It is quite true that the reports of sales of glucose and mixed sirups filed with the government show that if all our company's plants were closed down there would still be ample production of glucose and mixed sirups for all requirements."

Texas Potash Deposits Being Investigated

Geological Survey Making Analyses of Well Cuttings in Oil Fields

In conformity with the purpose of keeping the public fully informed regarding the progress of discoveries in the search for potash in western Texas, the director of the United States Geological Survey, Department of the Interior, has issued a statement of the results of the examination of samples of cuttings from two wells recently drilled there—the McDowell well No. 4, in Glasscock County, and the Texon Oil & Land Co.'s Santa Rita well, in Reagan County. The samples represent cuttings reaching depths of 2,550 and 4,426 ft. respectively in the two wells, but no samples representing a gap of 680 ft. between 1,010 and 1,605 ft. have been received from the McDowell well. There is also a gap of 2,205 ft. between the 1,683 and 3,888 ft. levels in the Santa Rita well from which no samples have been received.

The samples from the McDowell well ranged from 61.3 to 97.8 per cent soluble salts containing from 1.63 to 9.95 per cent K_2O . Those from the Santa Rita well showed from 47.4 to 93.7 per cent soluble salts containing from 1.86 to 10.78 per cent K_2O .

The samples thus analyzed, like those described in earlier announcements, were taken by standard tools from wells drilled primarily for oil. So many of the conditions attending the sampling are unknown that it is impossible to state whether the potash-bearing zones are a few feet or only a few inches thick. In the Santa Rita well, for example, the original sample taken from the bailer after the drill had cut the beds from 1,316 to 1,325 ft. showed 8.29 per cent of potash, equivalent to 10.78 per cent of the soluble salts, yet it cannot be safely inferred that there is a 9-ft. bed of potash salts of the stated richness at that horizon. Continuous sampling with core drills will be necessary before accurate data can be obtained.

Natural Indigo Production in India Falls Off

According to the first indigo forecast issued by the Department of Statistics of India, and based on reports received from six provinces, which contain practically the whole area under indigo in British India, the total area sown is estimated at 226,900 acres, which is 4 per cent below the estimate at the corresponding date of last year. As compared with the final estimate of last year (316,600 acres), the present estimate shows a decrease of 89,700 acres, or 28 per cent. The total yield of dye is at present estimated at 4,100,000 lb., as against 4,250,000 lb., the estimate at this time last year. As compared with the final estimate of last year, the present estimate shows a decrease of 33 per cent. Weather conditions at sowing time were not very favorable.

Cement Association Meets in Chicago

Officials of cement plants in all sections of the United States and Canada attended the sessions of the twentieth annual convention of the Portland Cement Association in Chicago last week. They brought optimistic reports as to improved conditions generally in the industry with bright prospects for the immediate future.

The convention opened Nov. 20, the various committees meeting in executive sessions to prepare reports which were submitted at the general sessions. L. T. Sunderland, president of the association, presided, and the program included the reading of papers on subjects pertaining to cement manufacture and mill practice. A. C. Tagge submitted a report of the special committee on accident prevention and insurance. C. H. Sonntag of the Cape Girardeau Portland Cement Co. read a paper on the waste heat installation in the plant of that company, and W. P. Gano, chief chemist, Pennsylvania Cement Co., read a paper explaining the different influences on the grinding of portland cement clinker.

A feature of the convention was the presentation by Secretary of Labor James J. Davis to the association of a concrete bust of Robert Whitman Lesley, the first president of the organization, which was modeled and cast by the boys of Mooseheart.

Wesson and Alexander at N. J. Chemical Society

Jerome Alexander and David Wesson were the speakers at the November meeting of the New Jersey Chemical Society in Newark, Nov. 13. The former chose as his topic, "The Importance of Impurities," and under this heading discussed a wide range of phenomena in industrial chemistry in which the presence of a small amount of "impurity" is essential for satisfactory results. It will be readily understood that the scope of such a subject is almost unlimited, and it was a fact that Mr. Alexander's remarks covered a miscellany of products and industries from electrodeposition to Welsbach mantles. The effect of varying quantities of cerium in the thorium impregnating solution used in incandescent gas mantles was described.

There followed two reels of motion pictures presented by Dr. Wesson, through the courtesy of the Kirkman Soap Co., showing the preparation of the raw materials entering into soap manufacture and the processes used in an up-to-date borax soap plant.

Dr. Wesson spoke on the subject of the color comparison of oils, describing the development of instruments used for this purpose from the first crude tintometer to the extremely accurate K. and E. spectrophotometer which measures the amount of light which passes through an oil for different wave lengths.

British Adhesives Research Committee Reports

Emphasizes Need for Systematic Investigation of Problems in Adhesive Manufacture

Early in 1918 it was estimated that within a year the shortage of glue would seriously limit the output of aircraft. In the latter part of 1917, however, the probability of a shortage had already been foreseen and the attention of the engineering war committee of the Royal Society was called, by a memorandum from one of its members, to the necessity for the scientific study of adhesives. This committee referred the matter to the Conjoint Board of Scientific Societies, which body called together an adhesives committee representative of the numerous aspects of the subject, both theoretical and practical.

INVESTIGATION SCOPE

Having in view the conserving of the existing supplies of raw materials for adhesives and cements, the committee set to work to devise improved and more economical methods of manufacture and to discover, if possible, new sources of supply. At the outset, the four following lines of inquiry were adopted:

1. An attempt to evolve physical and mechanical glue tests such as would differentiate between samples of tolerable merit. In this way it was hoped to obtain a closer knowledge of the characteristics of good adhesive cements and glues for wood.
2. To ascertain to what substance or substances and to what properties of such substances the adhesive strength of the gelatine base glues is due.
3. To discover whether and where wastage of raw material occurred in the course of the existing manufacturing processes and to suggest a remedy.
4. To examine, from the point of view of their adhesive power, the physical properties of substances obtainable from sources other than bone, hide or casein, and, if possible, from waste products of which supplies existed in England.

For several months the work of the committee proceeded along these lines and a number of useful results were obtained and are described in the first report. The experience already gained had shown that the need for a systematic investigation of the general problems of adhesives was very great and the results and experience already obtained gave hope of success.

WIDESPREAD APPLICATION

Adhesives are materials of very widespread application in industry; practically every branch of manufacture utilizes them in some form at some stage. Considerable progress has been made in the development of vegetable adhesives and in their industrial applications. Much work has also been done upon the chemistry of gelatine and gelatine glues, and in particular an attempt has

Experiments on Blast-Furnace Operation

Although the chemistry of iron blast-furnace reactions are fairly well understood, it has not been possible, due to the size of the commercial iron blast furnace and the loss involved when a furnace freezes, to operate a furnace experimentally except within those narrow limits which operating practice has proved not to be dangerous. Such being the case, the metallurgists of the Bureau of Mines have for some time past been carrying on experimental research work having for its ultimate object the construction of an experimental iron blast furnace of such dimensions as to be operated continuously and during the operation of which the conditions in the furnace would approximate those obtained in regular blast-furnace practice.

Based upon the data obtained from thirty-three different experiments, the bureau's metallurgists at its station at Minneapolis designed and constructed an experimental iron blast furnace. A 10-day test was recently made wherein no mechanical difficulties were encountered which materially hampered the operation of the furnace. The test also cleared up several metallurgical points concerning which considerable doubt had previously existed, such as the ability of a small experimental furnace to make "bosh gas" (35 per cent CO, 65 per cent N₂ in the combustion or tuyere zone); the size of the coke necessary; the number and size of tuyeres; amount of wind necessary; temperature of the blast, and temperature of the coke reaching the tuyere. It was likewise doubtful whether a small furnace would produce a gas sufficiently reducing in character to reduce oxides of iron and manganese; whether it would be possible to incorporate the proper amount of carbon in the metal produced; and whether the slag and metal could be removed from the crucible at the proper time.

been made to discover the nature of the changes occurring during the formation of gelatine from its precursors in animal tissues.

In the manufacture of glues and other adhesives there are very wide variations in the processes employed by different firms and in the character of their finished products. It would seem, indeed, that with a few exceptions the manufacturing processes employed in England are purely empirical, and without any real scientific basis. From this frequently follows an output of lower yield and grade than should be the case. It is hoped that the investigations of the committee will be of assistance in the evolution of a sound technology of glue manufacture. There exists a prejudice against adhesives, other than the common gums, derived from vegetable sources. It seems by no means improbable that valuable adhesives should be obtainable from such sources, and this expectation is strengthened by the results which have so far been gathered.

Report of Canadian Chemical Industries

The gross value of chemicals and allied products manufactured in Canada in 1920 was approximately \$122,000,000, according to a report published from the Dominion Bureau of Statistics at Ottawa.

The report states that the actual capital invested in the 456 plants operating in this group of industries in 1920 was \$120,000,000. Pigments, paints and varnishes made in forty-eight plants were valued at \$27,000,000 and with this output was first in the field. The report covers ten principal industries producing, respectively, coal tar and its products; acids, alkalis, salts and compressed gases; explosives, ammunition, fireworks and matches; fertilizers; medicinal and pharmaceutical preparations; paints, pigments and varnishes; soap, perfumery, cosmetics and toilet preparations; inks, dyes and colors; wood distillates and extracts; miscellaneous chemical industries.

IMPORT STATISTICS

The imports of chemicals and allied products into Canada have gradually increased from \$3,469,000 in 1895 to \$24,000,000 in the 12 months ended March, 1922. The exports of Canadian products of the same class has risen from \$760,000 in 1892 to \$9,000,000 in the 12 months ended March of the present year. During the war the great production of explosives in Canada and the shipment of this commodity to the war zone raised the Canadian exports of chemical products to a grand total of \$57,000,000 in the 12 months ended March, 1919. The present export figures show that much of the advantage gained in the war-time development has been retained, and the fact that the summary statistics for the calendar year 1921 showed that 444 plants were in operation as compared with 456 in the preceding year is further evidence that the chemical industries of Canada are more than holding their own.

Copies of the report on chemicals and allied products for 1919 and 1920 may be had on application to the Dominion Bureau of Statistics, Ottawa.

Illinois Industries Urged to Save Coal

Industrials in Illinois are urged to conserve and store coal by the Illinois Manufacturers' Association. In an effort to aid fuel economy the association has sent out hints based on a circular issued by the engineering experiment station of the University of Illinois. These hints deal particularly with fuel economy in the operation of hand-fired power plants and point out that practically the only fuel available for power plant use in Illinois under present conditions is bituminous coal from the central fields of Illinois, Indiana and western Kentucky.

"The care with which the coal is 'prepared' and separated into different

sizes is an important factor affecting its value in the power plant," the circular states. "The B.t.u. value and the percentage of ash furnish a general guide to the relative values of Illinois coals. Generally the coals having the lowest ash content have the highest B.t.u. value."

The circular recommends the storage of bituminous coal, provided the prescribed precautions are observed. It also enumerates the conditions necessary for complete and smokeless combustion of bituminous coals.

Novel Government Guide to Latin America

The new revised edition of the "Commercial Travelers' Guide to Latin America" has just been released by the Department of Commerce. It is an encyclopedia of the countries south of the United States. It is the only complete and up-to-date "Baedeker" for the traveler. Everything that a foreign representative should know is included within its 698 pages; salesmen's equipment, steamship routes and railroads, connections and rates, schedules of sailings, postal and cable services and rates, hotel accommodations in the various cities, restrictions on travelers, duties on samples and advertising matter.

Everything a commercial traveler ought to know about the twenty republics and the many colonies to the south of us to make a trip profitable as well as enjoyable is encompassed within these 734 pages; steamship lines and railroads, time tables and connections, road routes, hotels and rates, taxes on travelers and restrictions, duties on samples and advertising matter; nothing essential is omitted. The traveler is told about the banks, postal service and postal rates, weights and measures, and all things that may obviate those vexatious delays which are especially troublesome to the uninformed and inexperienced traveler in Latin America.

Every city and market of importance in the Latin Americas is listed with information as to its characteristics, trade regulations, license fees, routes by which to reach it, etc., and the traveler is given abundant sound advice to be followed in canvassing each section.

This rather unusual publication is a decided novelty—quite a departure from the usual routine of official bulletins. Its attractive binding, with stout flexible covers, thin paper and convenient paragraph headings, is an unusual feature. One of the most important items in the guide is the series of more than forty maps which were specially drawn for this publication and are based upon the most recent authentic data regarding railway lines, commercial centers, etc. The guide may be obtained by applying to the Superintendent of Documents, Government Printing Office, Washington, D. C., or to any of the district or co-operative offices of the Bureau of Foreign and Domestic Commerce, price \$1.25 prepaid.

Automobile Interests Finance Oil Refinery in Canada

Ground has been broken in Montreal, Canada, for one of the largest and most up-to-date oil refineries on the continent. It is being financed by prominent Canadians, associated with a group of Detroit automobile manufacturers, headed by Benjamin Briscoe, who since selling his Briscoe Motor Corporation interests in 1917 is now one of the principal stockholders in the Gray and the Durant motor companies. The new corporation, the Red Star Refineries, Ltd., with a paid-up capital of \$6,000,000, controls the Ramage process for the refining of petroleum. It is claimed for this process that a much superior quality of gasoline is obtained from the crude oil.

The Red Star Refinery now under construction is on the St. Lawrence River, on deep water, where the company's tankers will bring the crude oil from Mexico and the Gulf ports. When finished, this refinery will have a capacity of 10,000 bbl. of "Super-Gas" per day.

Personal

C. F. GEIGER, ceramic engineer of the Carborundum Co., Keasbey, N. J., was the principal speaker at the regular monthly meeting of the Rutgers Ceramic Club, Rutgers College, New Brunswick, N. J., Nov. 16. He gave an illustrated address on "Carborundum Refractories."

IVAR J. MOLTKEHANSEN, after 20 years practice in the United States, Norway and Belgium, has opened offices as a consulting electrochemical engineer at 44 Avenue Beau Séjour and 13 Rue Bréderode, Brussels, Belgium.

ARTHUR ROSENHAIN of England will deliver the second annual lecture before the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers on Feb. 19, 1923. His subject will be "Solid Solutions."

W. R. SHIMER, metallurgist of the Bethlehem Steel Co., Bethlehem, Pa., addressed the Washington Chapter of the American Society for Steel Treating, Nov. 24, 1922, on "The Manufacture of Steel."

VICTOR YNGVE has resigned his position with the Hydrol Co. of Niagara Falls, N. Y., to accept a research fellowship in cryogenic engineering at Harvard University, Cambridge, Mass.

Obituary

SPENCER KELLOGG, head of Spencer Kellogg & Sons, Inc., Buffalo, N. Y., producers of linseed, core and other oils, died at his residence, Nov. 14, at the age of 71 years, as a result of an attack of acute indigestion. He entered the linseed oil business in 1872.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

The Significance of the Stock Dividend

Many Companies in the Chemical and Allied Industries Are Capitalizing Their Accumulated Surpluses by Participating in This Record Distribution

DURING the past few weeks has occurred the largest distribution of stock dividends in the history of finance. The total issue announced by forty stock companies during the last 30 days amounts to \$1,119,000,000, or slightly more than this country's total national debt in 1914. The fact that the chemical and related industries have figured prominently in this movement may be regarded as convincing evidence of the widespread improvement occurring in these industries and also as an encouraging forecast of the earnings which these companies are likely to show in their annual reports for 1922.

A number of reasons have been assigned for the distribution of these dividends at this time, but it is believed that the principal motive may be found in the 1921 revenue law. That law differs from its predecessors in that it prescribes a flat rate of 12½ per cent on corporation profits. On the other hand, the tax on individual incomes remains as in 1920 and 1921 on a sliding scale—the surtax steadily increasing from 1 to 65 per cent depending upon the size of the income. Another novel feature of the revenue law, known as the capital investment tax, makes it possible for large holders of securities, which have been owned for a period of 2 years or more, to liquidate their holdings and pay a straight tax of 12½ per cent on the profit from this sale, instead of paying the regular surtaxes.

Accordingly for some time there has been a tendency to forestall heavy outlays for taxation by allowing profits to remain in the business. This has brought about large accumulations of surplus accounts by many companies. In order to put this money to a more useful purpose, and guided perhaps by the rumors that Congress might attempt to impose a heavy tax on all accumulated surpluses, many concerns have found it advisable to capitalize their surplus accounts in the form of stock dividends.

An example may serve to show more clearly how the law operates. Suppose John Smith has a personal income of \$75,000, on which he is required to pay the government a surtax at the rate of 35 per cent. Suppose, too, he owns a controlling interest in a corporation whose earnings would permit the payment to him of a cash dividend of

\$25,000. If he accepts that as cash, his income is increased to \$100,000, and he must pay a surtax at the rate of 47 per cent. Naturally he does not want to accept such a dividend, for by leaving his profits in the business, only 12½ per cent need be paid in taxes.

STANDARD OIL AND DU PONT DIVIDENDS

The Standard Oil companies in New Jersey, New York, California, Kansas and Kentucky were among the first to announce stock dividends. That of the New Jersey company, which amounted to 400 per cent of its capital stock and corresponded to a distribution at par value of \$395,517,000, was given wide publicity by members of Congress, who attempted to interpret the action as a tax evasion. Many other oil companies followed the example of the Standard companies, as may be observed from the accompanying compilation.

On Dec. 4 the directors of E. I. du Pont de Nemours & Co. will, with the approval of their stockholders, declare a 50 per cent stock dividend. The authorized capital stock was increased on Nov. 10 from \$80,000,000 to \$100,000,000 by the addition of 200,000 shares of \$100 par value. The dividend rate for the new issue will be announced by the directors at their February meeting but it is generally believed that it will be the same as that on the old stock, namely \$8 per share.

Since the du Pont stock was listed on the New York Stock Exchange in May, 1922, it has increased in value from \$115 per share to \$169.25 on Nov. 10. By Nov. 21 it had fallen off slightly to \$154. In its annual report for last year the du Pont company

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	162.45
Last week	162.83
November, 1921	146.82
November, 1920	240
April, 1918 (high)	286
April, 1921 (low)	140

The only items to show a change during the past week were caustic soda and linseed oil—both of which fell off slightly during the interval. The only effect on the index, however, was to lower it 0.38 of a point.

Taxes Claim One-Sixth of the National Income

In the fiscal year 1913-1914, taxes paid to national, state and local governments in the United States represented 6.4 per cent of the national income. By 1919-1920 the ratio had grown to 13 per cent and by 1920-1921 to 14.3 per cent. In the calendar year 1921, one-sixth of the current national income was diverted into tax channels for the support of governmental bodies in the United States.

This is one of the conclusions drawn by the National Industrial Conference Board after a comprehensive study of public expenditures and taxation in this country and abroad. "Under present conditions," the Conference Board's report concludes, "the tax bill in the United States is fast making inroads on the surplus necessary for economic progress and threatens materially to hamper our growth, especially in view of the uninterrupted rise in local government taxes. It is a question of growing importance whether a reduction in and wider diffusion of national tax burden may not be desirable, not only for the protection of the national surplus but in order to awaken a more general interest in the activities of the government."

reported that it had 10,579 stockholders, of whom 3,342, or 35 per cent, were employees.

Among the important industrials in the chemical, metallurgical and allied fields that have recently declared stock dividends are the following:

Company	Per Cent	Par Value Distributed (000 Omitted)
Standard Oil Co. of N. J.	400	\$395,517
Standard Oil Co. of N. Y.	200	150,000
Standard Oil Co. of Cal.	100	100,971
Standard Oil Co. of Kans.	300	6,000
Standard Oil Co. of Ky.	33½	2,000
E. I. du Pont de Nemours Co. *	50	20,000
Magnolia Petroleum Co.	50	58,675
Solar Refining Co.	100	2,000
Ohio Oil Co.	300	45,000
National Biscuit Co.	75	22,927
Vacuum Oil Co.	300	45,000
National Fuel Gas Co.	100	18,500
National Sugar Co.	50	5,000
U. S. Gypsum Co.	10	991
Great Northern Paper Co.	200	16,800
Ingersoll-Rand Co.	100	15,000
Pan American Petroleum Co.	25	17,500
Seovill Mfg. Co.	200	10,000
Timken-Detroit Axle Co.	150	4,467
Union Natural Gas Co.	75	7,500
American Steel Foundry Co.	18	3,600
Hercules Powder Co.	100	10,000
American Mach. & Fdry. Co.	200	4,000
Gulf Oil Corp. †	200	72,290
Pure Oil Co.	75	1,568

*Pending stockholders' approval, Dec. 4, 1922.

†Not announced as a stock dividend but distributed to stockholders under a capital readjustment plan.

Coal Problem Solved for This Winter (Except the Price)

The fuel situation has become stabilized to such an extent that the Chamber of Commerce of the United States recently notified its members that surveys and reports are no longer necessary, as the program adopted in September to equalize coal distribution, through co-operation among users in the period immediately following the strike, has been successful.

The resumption of large-scale industries such as steel plants and the relatively high operation of other plants show that industrial coal is adequately distributed and there is no apprehension about future supplies. The domestic user is clearly assured of domestic supplies, although individual preference as to kind and description may not always be met and may require some substitution of other coal.

COAL PRODUCTION UP

The United States Geological Survey reports that bituminous coal production for the week Nov. 13-18 was 11,213,000 tons, as against 10,147,000 tons in the week preceding. Early returns for the week Nov. 20-25 indicate that 11,000,000 tons will be raised. Both bituminous coal and anthracite output in the week ended Nov. 18 were at high rates, and the total coal raised, 13,404,000 net tons, was the highest weekly outturn since the strike and was exceeded this year only in the week ended March 25, when the total outturn was 13,543,000 net tons.

BEEHIVE COKE OUTPUT

Production of beehive coke continued to improve during the week ended Nov. 18. The estimated total output, based on the number of cars loaded, was 261,000 net tons, against 246,000 tons in the week preceding. Increased activity in the Pennsylvania-Ohio district was the principal factor in the improvement. According to the Contract was the principal factor in the Connellsville region increased from 176,880 to 182,380 tons, the highest record attained since the beginning of the strike.

The cumulative output during 1922 to date stands at 6,310,000 net tons. In the corresponding period of the 4 years preceding it was as follows: 1921, 4,826,000 tons; 1920, 18,826,000; 1919, 17,376,000, and 1918, 27,627,000.

National Lead Pays Eight Per Cent

By declaring a quarterly dividend of 2 per cent on Nov. 23, the National Lead Co. placed its common stock on an 8 per cent premium basis as compared with the previous rate of 6 per cent. The dividend is payable Dec. 30 to stock of record on Dec. 15. The statement was made by President Cornish that the \$4,000,000 in unissued common stock held by the company will remain as a reserve to be used for the extension of the business of the National Lead Co. and its subsidiaries.

The New York Market

NEW YORK, Nov. 20, 1922.

The chemical market continued along moderately active lines during the past week. Inquiries were quite abundant from various consuming industries for contracts over next year on some of the more important commodities, but as yet the producers have not shown any general inclination to accept this business. Resale stocks have been noticeably diminished and producers reported a sold-up condition for the remainder of the year on some products. Powdered white arsenic continued to be the feature of the week's trading and prices have reached new high levels. Actual transactions to the consuming industries have not been plentiful, but speculation among second hands on limited spot stocks has been the chief cause of the steady advance. Producers of acetate of lime announced another advance of 1/2c. per lb. Increased production costs and a stronger demand have been responsible for the new price.

The alkali market has also shown an appreciable improvement, especially for domestic consumption. Large producers seem well satisfied with the present volume of business and state that some new inquiries have recently been received from Japan and Italy for large tonnages. Red prussiate of potash is exceedingly strong on spot and sellers are asking top prices on limited stocks. Muriate of potash prices were advanced by leading importers. Formaldehyde retained its former strength without any quotable change.

GENERAL AND SPECIAL CHEMICALS

Acetate of Lime—Producers advanced the market to \$3.50 per 100 lb., for carload quantities, in bags. Higher production costs and better demand are responsible for the new price.

Arsenic—Quotations have again been advanced to 13 1/2c. per lb. and the market during the latter part of the week was firmly established at this level. The insecticide industry has shown considerable activity.

Bichromate of Soda—Sales have been recorded at 7 1/2@7 3/4c. per lb. for spot material and the market appeared firm at this level. Export business was fairly active.

Barium Chloride—The lowest figure heard for spot material was around \$95 per ton, with the range at \$95@\$100, according to quantity. Shipments from abroad were held at \$92 per ton.

Caustic Soda—The export market continued along moderate lines and prices were fractionally lower. The bulk of trading, however, is being done among domestic consumers. Contracts for the balance of the year are in very strong demand. Producers have not announced any prices for 1923. Spot quotations f.a.s. range around \$3.50@\$3.60 per 100 lb., with ex-warehouse goods held at \$3.75@\$4 per 100 lb.

Muriate of Potash—Quotations are somewhat higher on imported material at \$35.75 per ton, basis 80 per cent.

Fluoride of Soda—Several sales of

imported material were recorded at 9 1/2c. per lb. Buyers are only purchasing for immediate requirements and the market showed some weak spots.

Oxalic Acid—Producers continue to quote 14c. per lb., f.o.b. works. Odd lots were heard around 14@15c. on the spot market. Foreign shipments were quoted at 13 1/2c. per lb., duty paid.

Sal Ammoniac—White granular imported goods were much firmer during the week and prices ranged around 6 1/2c. per lb. The gray material continued firm at 8 1/2c. per lb.

Soda Ash—Domestic demand has been quite strong and producers report heavy shipments at \$1.75@\$1.80 per 100 lb. for the 58 per cent, light, single bags. The export demand is moderate.

VEGETABLE OILS

Linseed Oil—Immediate shipment oil was quoted down to 85c. per gal., due to the unfavorable reports from the Argentine market. Late December delivery was reported at 82c. per gal., carload lots, in barrels. January-April oil was offered at 76@78c. per gal.

Coconut Oil—A good inquiry was reported for the Ceylon type oil, but the high figures restricted trading to a considerable extent. Prompt shipments held around 8c. per lb.

Corn Oil—The market for crude oil ruled steady at 8 1/2c. per lb., f.o.b. Chicago, sellers' tanks. Spot oil in barrels was available in a small way at 10@10 1/2c. per lb.

Palm Oil—Foreign despatches reported a steady market, although spot prices remained quotably unchanged. Niger oil on spot was very scarce at 7 1/2c. per lb.

Peanut Oil—Domestic crude oil was purely nominal in the absence of any new crop offerings. The high cost of peanuts makes it almost impossible to produce any oil. Refined edible oil on spot was scarce at 13 1/2@14c. per lb. in barrels.

CRUDE RUBBER

General conditions in this market were somewhat easier during the past week and prices showed fractional declines for deliveries up to March, 1923. Trading was merely routine and buyers showed some disposition to hesitate at the present high levels. Smoked ribbed sheets and first latex were quoted at 24c. per lb. for December. January-March held at 24 1/2c. and April-June at 25 1/2c. per lb.

The Chicago Market

CHICAGO, Nov. 23, 1922.

But little change could be noticed in the condition of the industrial chemical market in this district. The tone of the market was firm, with both dealers and manufacturers reporting a very satisfactory volume of business. Its main feature has been the rapidly advancing prices on wood chemicals, which have risen nearly 100 per cent during the past 6 weeks. Imported chemicals are now at about the same price as domestic and in some instances higher.

Caustic soda maintained its firm posi-

tion and dealers report a good volume moving to the consuming trade. Prices were unchanged, with the solid 76 per cent quoted in ton lots at \$3.50 100 lb. and the ground or flake in similar lots at \$4.25. *Caustic potash* lacked quotable change and was reported as moving in a fair way at 7½@7¼c. per lb. *Soda ash* continued to be in good demand and supplies were available at \$2.25 per 100 lb.

Potash alum was quiet, with mostly foreign material offered. The U.S.P. lump was quoted in small or moderate lots at 4¼c. per lb. and the same grade in powdered form at 6¼c. *Barium compounds* were unchanged in price and were rather quiet. The chloride was available in ton lots at \$110 per ton and the carbonate at \$90. *Barium hydrate* crystals were in limited request and spot goods could have been had at 6@6¼c. per lb. *Ammonium chloride* moved in a routine way and the white granular was quoted at 7¼@8c. per lb. *Ammonium carbonate* was quiet, with spot stocks of the lump held for 11c. per lb. *Copper sulphate* was unchanged in price and moved in a fair way at 6c. per lb. for small or moderate lots. *Carbon bisulphide* was scarce on spot and was held at 7¼c. per lb. for single drums. *Carbon tetrachloride* was reported to be in good demand and spot stocks were quoted at 9@9¼c. per lb. Following the advance on methanol *formaldehyde* was advanced to 15¼c. per lb. in barrels. The advance was firmly maintained and dealers reported a very good volume of business at the new level. *Glycerine* was in a somewhat weaker position but the price of 18¼c. per lb. for the c.p. material was maintained. *Lead acetate* was in fair demand and material on spot was quoted at 12½@13c. per lb. for the white granular.

Bichromates were firm and unchanged in price, with fair supplies reported to be moving to the consuming trade. *Potassium bichromate* was quoted at 12@13c. per lb., and the sodium salt at 9@9¼c. *Potassium bicarbonate* was dull at 9½@10c. per lb. for the U.S.P. crystals. *Cyanide of potash* was very scarce and single-case lots were available from one source at 55c. per lb. *Red prussiate of potash* continued very scarce with only very small lots available at 95c.@\$1 per lb. *Potassium permanganate* was rather quiet, with supplies of the U.S.P. small crystals quoted at 18½@19c. per lb. *Chlorate of potash* was very firm and small lots of powdered were quoted at 9c. per lb.

LINSEED OIL AND TURPENTINE

Turpentine is now so high priced that very little is moving and some of the consumers are taking up substitutes. Single-drum lots were offered for immediate acceptance at the opening of today's market at \$1.69 per gal.

Linseed oil was firm in price, but the movement was reported as light. Single drums of the boiled was offered today at 95c. per gal. with similar quantities of the raw at 93c.

The Iron and Steel Market

PITTSBURGH, Nov. 24, 1922.

Steel mill operations seem to have had a slight further increase in the past week or two. Steel ingot production was at about 40,000,000 gross tons a year in October and may be estimated at a slightly higher rate this month. Cars are still in poor supply and from time to time there are various embargoes, but on the whole the current output is being shipped, together with some of the steel previously accumulated.

In wire products and tubular goods customers are exerting pressure upon the mills for heavier deliveries. In other lines there is no such pressure, but deliveries are evidently accepted freely, at as high rates as the mills can compass.

FINISHED STEEL MARKETS STAGNANT

As to actual sales and purchases, the finished steel markets on the whole are very quiet, practically stagnant, with certain important exceptions. Railroads continue to buy freely, orders reaching mills both direct from railroads and from car and locomotive shops, which are selling their product freely and have large inquiries before them. The automobile factories have formulated programs of production to April 1, and are in the market for the requisite steel. Although they are seeking as low prices as possible, they do not conceal their expectation of heavy operation. December is to be a light month in automobile production with the three succeeding months showing increases, the program involving heavier production in March than in any month of this year. The agricultural implement factories, while not operating particularly well, are doing better than formerly, and are buying some steel. The remarkable boom in garage and dwelling house construction causes pressure for delivery of nails and the smaller sizes of merchant pipe, and there is no little current buying of these.

PRICES BARELY STEADY

In general, however, the finished steel market is quiet, and prices, far from advancing as they were doing for so many months, are barely steady. In view of certain long-range considerations, the ready acceptance of the present heavy deliveries is somewhat noteworthy. There is the general fact that steel prices advanced, on an average, rather sharply in connection with the coal strike, and the coal strike ended some time ago. The steel industry is left with higher costs than last March, but with the price level considerably higher still, and in the light of precedent the average buyer may be expected to seek lower prices before buying freely again. Another consideration is that production of steel since Oct. 1 has been at a rate more than 15 per cent greater than in the 6 months April 1 to Oct. 1. On account of the drastic liquidation in 1921, consumption April 1 to Oct. 1 could not have ex-

ceeded production, while now production is considerably greater and it is not the time of year for consumption to increase. This observation, noted in last week's report, applies with still greater force now and will apply probably until steel production begins to taper off, of which there is no visible premonition at present.

STEEL PRICES

Yesterday the American Sheet & Tin Plate Co. made its long-awaited announcement of sheet and tin plate prices for new periods. Contrary to expectations entertained very generally a month ago and still maintained in a few quarters, no advances are made, all prices being reaffirmed for the new periods. Tin plate is \$4.75 per base box, 100 lb., for first quarter with jobbers and first half with manufacturing consumers, while sheets to all classes of trade for first quarter are 2.50c. for blue annealed, 3.35c. for black, 4.35c. for galvanized and 4.70c. for automobile. Independent tin plate makers had not been obtaining higher prices, although they insisted they ought to have higher prices. For a couple of months, all independents were obtaining higher prices for sheets, but lately there has been a recession to the Steel Corporation level, with the exception of automobile sheets, for which independents have still been trying to obtain 5c.

Bars, shapes and plates remain quotable at 2c., but the market is barely steady at that level, and no particular attempt is made to conceal the fact that on decidedly attractive orders slightly lower prices would readily be quoted by several sellers. Early deliveries are easily obtained. Delivery premiums on these lines disappeared recently.

Pipe remains quotable at 66 per cent basing discount, wire at 2.45c. and nails at \$2.70. Hoops and bands are easier, desirable orders going at 2.75c., against 2.90c. formerly.

COKE AND PIG IRON

The lack of coherence in market developments, or accidents, is illustrated by the fact that coal is down 50c. in the week, while coke, which is made from coal, is up 50c. and pig iron, which is made with coke, is down. Pittsburgh district steam coal is \$2.75@\$3, with byproduct at \$3.50@\$3.60 and high-grade gas coal at \$3.60@\$3.75. Connellsville furnace coke is \$7.25@\$7.50 for spot or prompt lots, and some of the best grades could scarcely be bought on contract to the end of the year at under \$8.

Valley bessemer is quoted at \$30 furnace, and it is not certain there would be any takers at that figure. Valley basic is offered at \$27.50, without any inquiry. Single carloads of valley foundry have been going at \$27.50. These prices are below those quoted a week ago by \$2 on bessemer, 50c. on basic and \$1 on foundry. The mere decline in prices is not remarkable, but the decline when there is so little inquiry to provoke active competition is distinctly notable.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.		\$0.39 - \$0.45
Acetone	lb.	\$0.19 - \$0.20	20 - 22
Acid, acetic, 28 per cent	100 lb.	2.92 - 3.00	3.05 - 3.20
Acetic, 56 per cent	100 lb.	5.85 - 5.90	5.95 - 6.25
Acetic, glacial, 99½ per cent, carboys	100 lb.	11.16 - 11.20	11.25 - 11.50
Boric, crystals	lb.	11 - 11½	11½ - 12
Boric, powder	lb.	11 - 11½	11½ - 12½
Citric	lb.		51 - 52
Hydrochloric, 18 d. g.	100 lb.	90 - 1.00	1.05 - 1.20
Hydrochloric, 20 deg.	100 lb.	1.00 - 1.10	1.20 - 1.40
Hydrofluoric, 52 per cent	lb.	11 - 11½	11½ - 12
Lactic, 44 per cent tech.	lb.	11 - 11½	11½ - 12
Lactic, 22 per cent tech.	lb.	06 - 06½	06½ - 07
Muriatic, 20 deg. (see hydrochloric)	lb.		06 - 06½
Nitric, 40 deg.	lb.	05 - 05½	06 - 06½
Nitric, 42 deg.	lb.	06 - 06½	06 - 07
Oxalic, crystals	lb.	15 - 15½	15½ - 16
Phosphoric, 50 per cent solution	lb.	07½ - 08	08½ - 09
Picric	lb.	20 - 22	23 - 27
Pyrogallol, resublimed	lb.		1.65 - 1.75
Sulphuric, 60 deg., tank cars	ton	9.00 - 10.00	
Sulphuric, 60 deg., drums	ton	12.00 - 14.00	
Sulphuric, 66 deg., tank cars	ton	11.50 - 15.00	
Sulphuric, 66 deg., drums	ton	19.00 - 20.00	20.50 - 21.00
Sulphuric, 66 deg., carboys	ton		
Sulphuric, fuming, 20 per cent (oleum)	ton	19.00 - 20.00	
Sulphuric, fuming, 20 per cent (oleum)	drums	22.00 - 22.50	23.00 - 24.00
Sulphuric, fuming, 20 per cent (oleum)	carboys	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.	lb.		60 - 75
Tannic (tech.)	lb.	40 - 45	46 - 50
Tartaric, imported crystals	lb.		30½ - 31
Tartaric acid, imported, powdered	lb.		31 - 32
Tartaric acid, domestic	lb.		32 - 33
Tungstic, per lb. of WO	lb.		1.00 - 1.20
Alcohol, ethyl (Cologne spirit)	gal.		4.75 - 4.95
Alcohol, methyl (see methanol)	gal.		
Alcohol, denatured, 188 proof No. 1	gal.		36 - 38
Alcohol, denatured, 188 proof No. 5	gal.		36 - 38
Alum, ammonia, lump	lb.	03½ - 03½	04 - 04½
Alum, potash, lump	lb.	03½ - 03½	03½ - 04
Alum, chrome lump	lb.	05 - 05½	05½ - 06
Aluminum sulphate, commercial	100 lb.	1.50 - 1.65	1.70 - 2.25
Aluminum sulphate, iron free	lb.	02½ - 02½	03 - 03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	06½ - 07½	07½ - 08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	30 - 30	30½ - 31
Ammonium carbonate, powder	lb.	08½ - 08½	09 - 09½
Ammonium nitrate	lb.	06 - 06½	06½ - 07½
Amylacetate tech.	gal.		2.35 - 2.60
Arsenic, white, powdered	lb.	13½ - 13½	14 - 14½
Arsenic, red, powdered	lb.	12½ - 12½	13 - 13½
Barium carbonate	ton	75.00 - 77.00	78.00 - 80.00
Barium chloride	ton	95.00 - 100.00	102.00 - 105.00
Barium dioxide (peroxide)	lb.	20 - 21	21½ - 22
Barium nitrate	lb.	08 - 08½	09 - 09½
Barium sulphate (precip.) (blanc fixe)	lb.	04 - 04½	04½ - 04½
Blanc fixe, dry	lb.	04 - 04½	
Blanc fixe, pulp	ton	45.00 - 55.00	
Bleaching powder	100 lb.	2.00 - 2.10	2.15 - 3.25
Blue vitriol (see copper sulphate)	lb.	05½ - 05½	06 - 06½
Borax	lb.		06 - 06½
Bromine (see sulphur, roll)	lb.		28½ - 35
Bromine	lb.	27 - 28	28½ - 35
Calcium acetate	100 lb.	3.50 - 3.60	3.65 - 3.75
Calcium carbide	lb.	04½ - 04½	05 - 05½
Calcium chloride, fused, lump	ton	22.00 - 23.00	23.50 - 27.00
Calcium chloride, granulated	lb.	01½ - 01½	02 - 02½
Calcium peroxide	lb.		1.40 - 1.50
Calcium phosphate, tribasic	lb.		15 - 16
Camphor	lb.		90 - 92
Carbon bisulphide	lb.	07 - 07½	07½ - 07½
Carbon tetrachloride, drums	lb.	10 - 10½	10½ - 12
Carbonyl chloride, (phosgene)	lb.		60 - 75
Caustic potash (see potassium hydroxide)	lb.		
Caustic soda (see sodium hydroxide)	lb.		
Chalk, precip.—domestic, light	lb.	04½ - 04½	
Chalk, precip.—domestic, heavy	lb.	03½ - 03½	
Chalk, precip.—imported, light	lb.	04½ - 05	
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	05½ - 06	06½ - 06½
Chloroform	lb.		35 - 38
Cobalt oxide	lb.		2.10 - 2.40
Copperas	ton	27.00 - 28.00	29.00 - 30.00
Copper carbonate, green precipitate	lb.	21 - 21½	22 - 22½
Copper cyanide	lb.		50 - 55
Copper sulphate, crystals	100 lb.	5.75 - 6.00	6.10 - 6.50
Cream of tartar	lb.		25½ - 26
Epsom salt (see magnesium sulphate)	lb.		14 - 15
Ether, U. S. P., 100 drums	gal.		72 - 75
Ethyl acetate com. 85%	gal.		
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.		90 - 95
Formaldehyde, 40 per cent	gal.	14½ - 14½	14 - 15
Fullers earth, f.o.b. mines	net ton	16.00 - 17.00	
Fullers earth—imported powdered	net ton	30.00 - 32.00	
Fuse oil, ref.	gal.		3.00 - 3.50
Fuel oil, crude	gal.		2.00 - 2.25
Glauber's salt (see sodium sulphate)	lb.		
Glycerine, c.p. drums extra	lb.		18 - 18½
Iodine, resublimed	lb.		4.40 - 4.50
Iron oxide, red	lb.		12 - 18
Lead acetate, white crystals	lb.		12 - 12½
Lead arsenate, powd.	lb.	13 - 13½	13½ - 14½
Lead nitrate	lb.		15 - 20
Litharge	lb.	07½ - 08	08½ - 09
Magnesium carbonate, technical	lb.	06 - 06½	06½ - 07½
Magnesium sulphate, U. S. P.	100 lb.	2.50 - 2.65	2.70 - 3.50
Magnesium sulphate, technical	100 lb.		1.00 - 1.80
Methanol, 95%	gal.		1.00 - 1.07
Methanol, 97%	gal.		1.03 - 1.10

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Nickel salt, double	lb.		\$0.11 - \$0.11½
Nickel salt, single	lb.		12 - 12½
Phosgene (see carbonyl chloride)	lb.		
Phosphorus, red	lb.		40 - 45
Phosphorus, yellow	lb.		30 - 35
Potassium bichromate	lb.	\$0.09½ - 10	10½ - 10
Potassium bromide, granular	lb.		17 - 23
Potassium carbonate, U. S. P.	lb.	12 - 12½	13 - 16
Potassium carbonate, 80-85%	lb.	06 - 06½	06½ - 06½
Potassium chlorate, powdered and crystals	lb.	07½ - 08	08½ - 09
Potassium cyanide	lb.		55 - 57
Potassium hydroxide (caustic potash)	100 lb.	6.50 - 6.60	6.65 - 7.00
Potassium iodide	lb.		3.45 - 3.55
Potassium nitrate	lb.	06½ - 06½	07 - 08
Potassium permanganate	lb.	16 - 16½	16½ - 17
Potassium prussiate, red	lb.		90 - 95
Potassium prussiate, yellow	lb.	39 - 39½	39½ - 40
Rochelle salts (see sodium potas. tartrate)	lb.	06½ - 07	07½ - 07½
Salammoniac, white, granular	lb.	08 - 08½	08½ - 08½
Salammoniac, gray, granular	lb.		1.45 - 1.60
Salsoda	100 lb.	1.20 - 1.40	
Salt cake (bulk)	ton	25.00 - 27.00	
Soda ash, light, 58 per cent flat, bags	100 lb.	1.60 - 1.67	2.00 - 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 - 1.80	1.85 - 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 - 1.90	1.95 - 2.40
Sodium acetate	lb.	07½ - 07½	08 - 08½
Sodium bicarbonate	100 lb.	1.75 - 1.85	1.90 - 2.30
Sodium bichromate	lb.	07½ - 07½	08 - 08½
Sodium bisulphate (nitre cake)	ton	4.50 - 4.60	4.65 - 5.50
Sodium bisulphate powdered, U. S. P.	lb.	04½ - 04½	04½ - 05½
Sodium chloride	long ton	12.00 - 13.00	12½ - 13
Sodium cyanide	lb.	19½ - 21	21½ - 25
Sodium fluoride	lb.	09 - 09½	10 - 10½
Sodium hydroxide (caustic soda) solid	100 lb.	3.35 - 3.40	3.75 - 4.00
76 per cent flat, drums, contract	100 lb.		
76% flat, drums, resale	100 lb.	3.50 - 3.60	3.65 - 4.00
Sodium hydroxide (caustic soda), ground	100 lb.	3.80 - 3.90	4.25 - 4.40
Sodium hydroxide (caustic soda) ground	100 lb.	4.00 - 4.15	4.40 - 4.60
Sodium hyposulphite	lb.	02½ - 02½	03 - 03½
Sodium nitrite	lb.	09 - 09½	09½ - 10
Sodium peroxide, powdered	lb.	28 - 30	31 - 35
Sodium phosphate, dibasic	lb.	03½ - 04	04½ - 04½
Sodium potassium tartrate (Rochelle salts)	lb.		18 - 21
Sodium prussiate, yellow	lb.	21½ - 21½	21½ - 22
Sodium silicate, (40 deg. in drums)	100 lb.	1.25 - 1.30	1.35 - 1.50
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 - 2.40	2.45 - 2.75
Sodium sulphate, crystals (Glauber's salt)	100 lb.	85 - 95	1.00 - 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	04 - 04½	04½ - 05
Sodium sulphite, crystals	lb.	03½ - 03½	03½ - 04½
Strontium nitrate, powdered	lb.	09 - 10	10½ - 12
Sulphur chloride, yellow	lb.	04½ - 05	05½ - 06
Sulphur, crude	ton	18.00 - 20.00	
Sulphur dioxide, liquid, cylinders extra	lb.	08 - 08½	09 - 10
Sulphur (sublimed), flour	100 lb.		2.25 - 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 - 2.15	2.20 - 2.70
Talc—imported	ton	30.00 - 40.00	
Talc—domestic powdered	ton	18.00 - 25.00	
Tin bichloride	lb.	11 - 11½	11½ - 11½
Tin oxide	lb.		43 - 45
Zinc carbonate	lb.	14 - 14½	14½ - 15
Zinc chloride, gran.	lb.	07 - 07½	07½ - 08
Zinc cyanide	lb.	42 - 44	45 - 47
Zinc oxide, XX	lb.	07½ - 08	08½ - 08½
Zinc sulphate	100 lb.	2.75 - 3.00	3.05 - 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N. Y.:

Alpha-naphthol, crude	lb.	\$0.90 - \$0.95
Alpha-naphthol, refined	lb.	1.05 - 1.10
Alpha-naphthylamine	lb.	28 - 30
Aniline oil, drums extra	lb.	16 - 17
Aniline salts	lb.	22 - 24
Anthracene, 80% in drums (100 lb.)	lb.	75 - 1.00
Anthracene, 80% imported in drums, duty paid	lb.	65 - 70
Benzaldehyde U. S. P.	lb.	1.25 - 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	30 - 35
Benzene, 90%, in drums (100 gal.)	gal.	28 - 32
Benzene, 90%, in drums, resale	gal.	37 - 40
Benzoic acid, base	lb.	85 - 90
Benzoic acid, U. S. P.	lb.	75 - 80
Benzoate of soda, U. S. P.	lb.	72 - 75
Benzyl chloride, 95-97%, refined	lb.	57 - 65
Benzyl chloride, tech.	lb.	25 - 27
Beta-naphthol benzate	lb.	20 - 23
Beta-naphthol, sublimed	lb.	3.75 - 4.00
Beta-naphthol, tech.	lb.	55 - 60
Beta-naphthylamine, technical	lb.	25 - 26
Carbazol	lb.	1.00 - 1.25
Cresol, U. S. P., in drums (100 lb.)	lb.	75 - 90
Ortho-cresol, in drums (100 lb.)	lb.	14 - 20
Ortho-cresol, 97-99%, straw color, in drums	gal.	18 - 22
Cresylic acid, 55-57%, dark, in drums	gal.	60 - 65
Cresylic acid, 97%, resale	gal.	55 - 58
Diethylbenzene	lb.	90 - 95
Diethylamine	lb.	07 - 09
Dimethylamine	lb.	50 - 60
Dinitrobenzene	lb.	39 - 41
Dinitrochlorobenzene	lb.	20 - 22
Dinitrofluorobenzene	lb.	22 - 23
Dinitronaphthalene	lb.	30 - 32
Dinitrophenol	lb.	32 - 34
Dinitrotoluene	lb.	22 - 24
Dip oil, 25%, car lots, in drums	gal.	25 - 30
Diphenylamine	lb.	54 - 56
H-acid	lb.	75 - 80
Meta-phenylenediamine	lb.	90 - 1.00
Monochlorobenzene	lb.	08 - 10
Mononitrobenzene	lb.	95 - 1.10
Naphthalene, crushed, in bbls.	lb.	06 - 06
Naphthalene, flake	lb.	06 - 06

Naphthalene, balls.....	lb.	\$0.07	—	\$0.07
Naphthionate of soda.....	lb.	.58	—	.65
Naphthionic acid, crude.....	lb.	.65	—	.70
Nitrobenzene.....	lb.	.10	—	.12
Nitro-naphthalene.....	lb.	.30	—	.35
Nitro-toluene.....	lb.	.15	—	.17
N-W acid.....	lb.	1.20	—	1.30
Ortho-aminophenol.....	lb.	2.25	—	2.30
Ortho-dichlor-benzene.....	lb.	.17	—	.20
Ortho-nitro-phenol.....	lb.	.85	—	.90
Ortho-nitro-toluene.....	lb.	.10	—	.12
Ortho-toluidine.....	lb.	.12	—	.14
Para-aminophenol, base.....	lb.	1.20	—	1.25
Para-aminophenol, HCl.....	lb.	1.25	—	1.30
Para-dichlorbenzene.....	lb.	.17	—	.20
Paranitroaniline.....	lb.	.72	—	.80
Para-nitrotoluene.....	lb.	.55	—	.65
Para-phenylenediamine.....	lb.	1.50	—	1.55
Para-toluidine.....	lb.	.85	—	.90
Phthalic anhydride.....	lb.	.37	—	.50
Phenol, U. S. F., drums.....	lb.	.34	—	.35
Pyridine, domestic.....	gal.	1.60	—	1.75
Pyridine, imported.....	gal.	1.40	—	1.60
Resorcinol, technical.....	lb.	1.50	—	1.55
Resorcinol, pure.....	lb.	2.00	—	2.10
R-salt.....	lb.	.55	—	.60
Salicylic acid, tech., in bbls.....	lb.	.29	—	.31
Salicylic acid, U. S. P.....	lb.	.35	—	.36
Solvent naphtha, water-white, in drums, 100 gal.....	gal.	.37	—	.40
Solvent naphtha, crude, heavy, in drums, 100 gal.....	gal.	.20	—	.23
Sulphanilic acid, crude.....	lb.	.24	—	.26
Tolidine.....	lb.	1.20	—	1.30
Toluidine, mixed.....	lb.	.30	—	.35
Toluene, in tank cars.....	gal.	.35	—	.37
Toluene, in drums.....	gal.	.40	—	.43
Xylidines, drums, 100 gal.....	lb.	.40	—	.45
Xylene, pure, in drums.....	gal.	.45	—	.50
Xylene, pure, in tank cars.....	gal.	.45	—	.50
Xylene, commercial, in drums, 100 gal.....	gal.	.40	—	.42
Xylene, commercial, in tank cars.....	gal.	.30	—	....

Waxes

All prices remain same as previous report.

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on earload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.....	280 lb.	\$6.50	—	....
Rosin E-I.....	280 lb.	6.55	—	....
Rosin K-N.....	280 lb.	6.65	—	\$7.10
Rosin W. G.-W. W.....	280 lb.	7.75	—	8.25
Wood rosin, bbl.....	280 lb.	6.25	—	....
Spirits of turpentine.....	gal.	1.57	—	1.58
Wood turpentine, steam dist.....	gal.	1.35	—	....
Wood turpentine, dest. dist.....	gal.	1.25	—	....
Pine tar pitch, bbl.....	200 lb.	....	—	6.00
Tar, kiln burned, bbl. (500 lb.).....	bbl.	....	—	12.50
Retort tar, bbl.....	500 lb.	....	—	11.00
Rosin oil, first run.....	gal.	.43	—	....
Rosin oil, second run.....	gal.	.51	—	....
Rosin oil, third run.....	gal.	.53	—	....
Pine oil, steam dist., sp.gr. 0.930-0.940.....	gal.	....	—	.90
Pine oil, pure, dest. dist.....	gal.	....	—	.85
Pine tar oil, ref., sp.gr. 1.025-1.035.....	gal.	....	—	.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal.	....	—	.35
Pine tar oil, double ref., sp.gr. 0.965-0.990.....	gal.	....	—	.75
Pine tar, ref., thin, sp.gr. 1.080-1.060.....	gal.	....	—	.25
Hardwood oil, f.o.b. Mich., sp.gr. 0.960-0.990.....	gal.	....	—	.25
Pinewood creosote, ref.....	gal.	....	—	.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags.....	100 lb.	3.55	—	3.60
Blood, dried, f.o.b., N. Y.....	unit	4.60	—	....
Bone, 3 and 50, ground, raw.....	ton	42.00	—	44.00
Fish scrap, dom., dried, f.o.b. works.....	unit	3.10	—	3.20
Nitrate of soda.....	100 lb.	2.45	—	2.47
Tankage, high grade, f.o.b. Chicago.....	unit	4.50	—	4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%.....	ton	3.50	—	4.00
Tennessee, 78-80%.....	ton	7.00	—	8.00
Potassium muriate, 80%.....	ton	35.75	—	38.50
Potassium sulphate.....	unit	1.00	—	....

Crude Rubber

Para-Upriver fine.....	lb.	\$0.23	—	.23
Upriver coarse.....	lb.	.17	—	.17
Upriver cauchoo ball.....	lb.	.18	—	.18
Plantation—First latex crepe.....	lb.	.24	—	.24
Ribbed smoked sheets.....	lb.	.24	—	.24
Brown crepe, thin, clean.....	lb.	.20	—	.20
Amber crepe No. 1.....	lb.	.20	—	.20

Oils

VEGETABLE

The following prices are f.o.b. New York for earload lots.

Castor oil, No. 3, in bbls.....	lb.	\$0.12	—	\$0.12
Castor oil, AA, in bbls.....	lb.	.12	—	.13
China wood oil, in bbls.....	lb.	.12	—	.12
Coconut oil, Ceylon grade, in bbls.....	lb.	.08	—	.08
Coconut oil, Cochon grade, in bbls.....	lb.	.09	—	.09
Corn oil, crude, in bbls.....	lb.	.10	—	.10
Cottonseed oil, crude (f. o. b. mill).....	lb.	.08	—	.10
Cottonseed oil, summer yellow.....	lb.	.10	—	.10
Cottonseed oil, winter yellow.....	lb.	.11	—	.11

Linseed oil, raw, ear lots (domestic) bbls.....	gal.	.85	—	.86
Linseed oil, raw, tank cars (domestic).....	gal.	.81	—	.82
Linseed oil, boiled, in 5-bbl lots (domestic).....	gal.	.87	—	.89
Olive oil, denatured.....	gal.	1.15	—	1.17
Palm, Lagos.....	lb.	.07	—	.07
Palm, Niger.....	lb.	.06	—	.07
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.10	—	.10
Peanut oil, refined, in bbls.....	lb.	.13	—	.13
Rapeseed oil, refined in bbls.....	gal.	.77	—	.78
Rapeseed oil, blown, in bbls.....	gal.	.84	—	.85
Soya bean oil (Manchurian), in bbls. N. Y.....	lb.	.11	—	....
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.09	—	.09

Miscellaneous Materials

Prices remain quotably unchanged.

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	\$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, earlots.....	lb.	.10	—	.10
Ferrochromium, per lb. of Cr contained, 4-6% carbon, earlots.....	lb.	.10	—	.11
Ferromanganese, 78-82% Mn, Atlantic seaboard.....	gross ton	67.50	—	69.00
Spiegelisen, 19-21% Mn.....	gross ton	39.00	—	40.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo.....	lb.	2.00	—	2.25
Ferrosilicon, 10-15%.....	gross ton	38.00	—	40.00
Ferrosilicon, 50%.....	gross ton	68.00	—	70.00
Ferrosilicon 75%.....	gross ton	115.00	—	120.00
Ferrotungsten, 70-80%, per lb. of contained W.....	lb.	.85	—	.90
Ferro-uranium, 35-50% of U, per lb. of U content.....	lb.	6.00	—	....
Ferrovanadium, 30-40% per lb. of contained V.....	lb.	3.50	—	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points.....	net ton	\$6.00	—	\$9.00
Chromite ore, Calif. concentrates, 50% min. Cr ₂ O ₃	ton	22.00	—	23.00
Chromite ore, 50% Cr ₂ O ₃ , c.i.f. Atlantic seaboard.....	ton	18.50	—	19.00
Coke, foundry, f.o.b. ovens.....	net ton	7.50	—	8.00
Coke, furnace, f.o.b. ovens.....	net ton	6.75	—	7.00
Fluorspar, gravel, f.o.b. mines, New Mexico.....	net ton	15.00	—	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines.....	net ton	17.50	—	19.00
Ilmenite, 52% TiO ₂ , per lb. ore.....	lb.	.01	—	.01
Manganese ore, 50% Mn, c.i.f. Atlantic seaport.....	unit	.45	—	....
Manganese ore, chemical (MnO ₂).....	net ton	75.00	—	80.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂ , N. Y.....	lb.	.80	—	.85
Monazite, per unit of ThO ₂ , c.i.f. Atlantic seaport.....	unit	27.00	—	....
Pyrites, Spanish, fines, c.i.f. Atlantic seaport.....	unit	.11	—	.12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport.....	unit	.11	—	.12
Pyrites, domestic, fines, f.o.b. mines, Ga.....	unit	Nominal	—	....
Rutile, 95% TiO ₂ per lb. ore.....	lb.	.12	—	....
Tungsten, scheelite, 60% WO ₃ and over, per unit of WO ₃ (nominal).....	unit	8.00	—	8.25
Tungsten, wolframite, 60% WO ₃ and over, per unit of WO ₃ , N. Y. C.....	unit	7.75	—	8.00
Uranium ore (carnotite) per lb. of U ₃ O ₈	lb.	1.25	—	1.75
Uranium oxide, 96% per lb. contained U ₃ O ₈	lb.	2.25	—	2.50
Vanadium pentoxide, 99%.....	lb.	12.00	—	14.00
Vanadium ore, per lb. of V ₂ O ₅ contained.....	lb.	1.00	—	....
Zircon, washed, iron free, f.o.b. Pablo, Florida.....	lb.	.04	—	.13

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic.....	13.90
Aluminum, 98 to 99 per cent.....	20.00-21.00
Antimony, wholesale lots, Chinese and Japanese.....	6.60
Nickel, ordinary (ingot).....	36.00
Nickel, electrolytic.....	39.00
Nickel, electrolytic, resale.....	32.00-33.00
Nickel, ingot and shot, resale.....	30.00-31.00
Monel metal, shot and blocks.....	32.00
Monel metal, ingots.....	35.00
Monel metal, sheet bars.....	38.00
Tin, 5-ton lots, Straits.....	36.375
Lead, New York, spot.....	7.00-7.20
Lead, E. St. Louis, spot.....	6.875-6.90
Zinc, spot, New York.....	7.40
Zinc, spot, E. St. Louis.....	7.05-7.10

OTHER METALS

Silver (commercial).....	oz.	\$0.64
Cadmium.....	lb.	1.15
Bismuth (500 lb. lots).....	lb.	2.45
Cobalt.....	lb.	3.00@3.25
Magnesium, ingots, 99 per cent.....	lb.	1.00@1.65
Platinum.....	oz.	\$108.00
Iridium.....	oz.	240.00@275.00
Palladium.....	oz.	52.00@55.00
Mercury.....	75 lb.	71.00

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

LEATHER—The Hiteman Leather Co., West Winfield, N. Y., has adopted an overtime working schedule at its local tannery. Maximum production is being maintained.

The Tunkhannock Tannery, Tunkhannock, Pa., is operating at full capacity, and has recently advanced the wage scale 10 per cent, making the second increase within the past few months. A full working force is employed.

The Standard Kid Co., Wilmington, Del., is advancing production at its tannery to a basis of 800 dozen daily, as compared with a former output of 600 dozen. The working force is being increased.

The Chain Leather Co., Peabody, Mass., operating on contract account, is maintaining active production at its tannery, and has recently placed a new hide house and other plant buildings in service. The working force is being held at close to normal.

RUBBER—The Republic Rubber Co., Youngstown, O., has commenced the manufacture of pneumatic tires at its local mill, and plans to develop a daily output of about 1,000 such tires at an early date. The company is also maintaining production at a high point at its mechanical rubber goods departments, and new monthly sales records are being established.

The mechanical rubber goods department of all mills at Akron, O., are running at full capacity, with full working forces. The majority of plants expect to maintain this schedule for an indefinite period. A number of tire-manufacturing plants are arranging for an increase in the present operating schedule.

The Lee Tire & Rubber Co., Conshohocken, Pa., is maintaining a high production program at its local mill, giving employment to a regular working force.

OIL—The Marland Refining Co., Ponca City, Okla., is advancing operations at its oil refinery. A new cracking plant is being completed with a capacity of about 1,800 bbl. of gas oil per day, and will increase the gasoline output about 25 per cent. It will be placed in service at an early date.

The Merritt Oil Co., operating in the Big Muddy Field, Wyo., a subsidiary of the Midwest Refining Co., Denver, Colo., has advanced production to a basis of 3,000 bbl. per day. The parent organization is taking a greater output from the Salt Creek Field, advancing capacity from 60,000 to 80,000 bbl. daily, gross.

IRON AND STEEL—The McKinney Steel Co. has blown in its blast furnace at Scottsdale, Pa., following a shut-down for about 24 months. The plant has a daily capacity of 350 tons and will be brought up to this point at an early date. Employment will be given to approximately 200 men.

The Pulaski Furnace Co., Pulaski, Va., has blown in its local blast furnace, following the reopening of its mines, quarries and coke ovens. Employment will be given to more than 250 men.

The American Steel & Wire Co. is preparing to operate at all of its Farrell mills in the vicinity of Sharon, Pa.

The Bourne-Fuller Co., Cleveland, O., has advanced production to a 100 per cent capacity basis at its mills.

All steel mills in the Birmingham, Ala., district are now running on a double turn, with extra working forces.

The American Swedo Iron Co., Danville, Pa., has inaugurated a night shift at its local mills, giving employment to a large increased working force. It is purposed to double the output.

Plants of the United States Steel Corporation in the Youngstown, O., district have advanced operations to better than 90 per cent of capacity. The majority of independent mills in this section are running in excess of 80 and 85 per cent.

A total of 230 blast furnaces are now operating in the eastern Pennsylvania district, the largest number for a year or more past.

At Joliet, Ill., 15 blast furnaces out of a total of 27 are now in operation. Independent companies in this section are run-

ning on a basis of from 70 to 75 per cent of normal.

The Gulf States Steel Co., Gadsden, Ala., is operating at 4 of its 6 open-hearth furnaces.

The National Tube Co., Lorain, O., has advanced operations to practically 100 per cent at its local mills.

The Trumbull Steel Co., Warren, O., is running at close to full capacity at its plant, with regular working force.

METALS—The Davis-Daly Co., Butte, Mont., is increasing production at its copper and silver properties, with monthly average totaling 21,000 tons to the smelter at East Butte. Employment is being to more than 300 men.

The Utah Copper Co., Salt Lake City, Utah, has commenced operations at the first unit of its Magna mill, which has been remodeled and improved. The unit will have a capacity of 1,000 tons, and will be supplemented by two additional units at an early date; the plant will have a total of 13 units, with rated output of more than 12,000 tons daily. The Arthur mill of the company is on the active list, running at 15,000 tons per day.

Foundries at Wrightsville, Pa., have advanced the wages of employees 5 per cent, effective Nov. 15, with a similar increase agreed upon at the first of the year. Among the plants affected are the Riverside Foundry Co., and the Susquehanna Casting Co., both running close to normal.

The United Engineering & Foundry Co. has resumed production at its Todd foundry, Youngstown, O., after a shut-down since May, 1918.

The Nevada Consolidated Copper Co. is running its McGill, Nev., smelter on the basis of 2,400 tons of copper ore per day, divided among 6 operating units. This will be advanced to 15 units in service shortly after the first of the year, with daily capacity of 6,000 tons.

Construction and Operation

Arizona

SUPERIOR—The Magma Copper Co. is perfecting plans for the erection of a new smelting plant at its properties. Other extensions and improvements will also be made.

California

MONOLITH—The Monolith Portland Cement Co. has inaugurated a program of extensions and improvements at its plant to increase the capacity to 3,000 bbl. per day. Additional equipment will be installed.

SIERRA CITY—E. C. Klinker and associates have taken over the Bigelow quartz properties, and plan for extensive production. Machinery will be installed, including equipment recently obtained from the Monarch Mine, in this same district. The Bigelow property has been inactive for some time past.

LOS ANGELES—The Shell Oil Co., San Francisco, has awarded a contract to the William A. Heitman Construction Co., 900 Merritt Bldg., Los Angeles, for the erection of the initial buildings for its new refining plant on a tract of land recently acquired at Wilmington, Los Angeles Harbor. The work will consist of a main refinery, pumping plant, stills, tanks, power house and a number of mechanical buildings, estimated to cost close to \$5,000,000, with machinery.

Connecticut

WATERBURY—The Connecticut Brass Co., Watertown Rd., has plans nearing completion for the erection of a new 1-story brass foundry. Work will be commenced at an early date.

Georgia

AUGUSTA—The Hills Molasses Mixture Co., 19 Jackson St., recently organized, has obtained a local building and will soon commence the installation of machinery for

the manufacture of insecticides for the destruction of the cotton boll weevil and other service. A list of equipment has been prepared. Frank H. Barrett is president.

GRIFFIN—Fire, Nov. 9 destroyed a portion of the fertilizer works of Gossett & Sons, with loss estimated at about \$20,000. It is planned to rebuild.

Indiana

INDIANAPOLIS—The Republic Creosoting Co., 1614 Merchants' Bank Bldg., has plans in progress for the erection of two 1-story additions to its plant at Maywood, 82x107 ft. and 40x40 ft., respectively. A new still, condenser and other equipment will be installed. Batchelder & Scales, 426 Board of Trade Bldg., are architects. Peter C. Reilly is president.

INDIANAPOLIS—The Puritan Bed Springs Co., 902 Kentucky Ave., will rebuild the portion of its enameling works, destroyed by fire, Nov. 8.

Kentucky

LOUISVILLE—The Standard Sanitary Mfg. Co., 6th and Shipp Sts., has plans nearing completion for the erection of a 1-story addition to its plant, 55x325 ft., to be used for the most part for the enamel department at the works, estimated to cost about \$75,000, including equipment. It will give employment to an increased working force of about 125 men.

OWENSBORO—The Bolger & Medley Co. has plans in progress for the establishment of a new local plant for the manufacture of face brick, hollow tile and other burned clay products. Work will begin at an early date.

Louisiana

NEW ORLEANS—The Atlantic Paint Co. has plans under way for the construction of a new 2-story brick plant, 30x140 ft., to replace its factory recently destroyed by fire. A general contract for the building will soon be let.

NEW ORLEANS—A. P. Orrick, 410 Chartres St., is making inquiries for machinery for the manufacture of soap and special soap shapes, to be installed in a local building.

SWARTZ—The Atlas Oil Co. has authorized the immediate preparation of plans for the erection of a new gasoline-refining plant, on the site of its former works, recently destroyed by fire with loss of about \$100,000, including equipment. The new structure will cost approximately a like amount.

Maine

MILLINOCKET—The Great Northern Paper Co. has work in progress on a new 1-story building at its plant, 60x180 ft., estimated to cost about \$25,000. C. P. Crowell and W. S. Lancaster, Exchange Bldg., Bangor, Me., are architects.

Maryland

SECURITY—The Security Cement & Lime Co., 116 West Washington St., Hagerstown, has commenced the erection of a new 1-story addition to its local cement mill for general increase in production. Other extensions will be made at the plant, including the installation of additional machinery. John Porter is general manager.

BALTIMORE—The American Oil Co., American Bldg., has taken title to the shipyard of the Henry Smith Shipbuilding Co., Curtis Bay, comprising about 10 acres of land, for a consideration of about \$90,000, and will use the site for a new storage and distributing plant. Plans are under way for the initial buildings, including steel tanks with a total capacity of 2,500,000 gal. and which later will be increased to 10,000,000 gal. A factory will also be established for the manufacture of soaps, greases and kindred specialties. The new plant is estimated to cost approximately \$500,000, including equipment.

CAMBRIDGE—The Dorchester Lime & Fertilizer Co., Trenton St., is completing plans for the erection of two new 1-story plant buildings, 100x150 ft. and 60x100 ft., to replace its plant recently destroyed by fire. A complete mixing and grinding unit will be installed, with capacity of about 20 tons per hour. The fire loss was approximately \$65,000, and the new work will cost a like amount. Lloyd Webster is president.

Massachusetts

BROCKTON—The Brockton Gas Co., 40 Centre St., has foundations under way for an addition to its artificial gas plant on Grove St., estimated to cost about \$100,000, including equipment.

EVERETT—The Beacon Oil Co., Beacham St., will commence the immediate erection of a 1-story building on Charles Court, 50x50 ft., for general operating service.

Michigan

PETOSKEY—The Petoskey Portland Cement Co. has tentative plans under consideration for enlargements in its plant for considerable increase in capacity. A number of buildings will be constructed, estimated to cost close to \$500,000, including machinery. J. C. Buckbee, First National Bank Bldg., Chicago, Ill., is consulting engineer.

DETROIT—Fire, Nov. 15, destroyed the local distributing plant of the Huron Portland Cement Co., Atwater and Riopelle Sts., with loss estimated at about \$250,000, including building, equipment and stock. Headquarters of the company are in the Ford Bldg.

BAY CITY—The City Council has commenced excavations for a new filtration plant at the municipal waterworks, estimated to cost about \$1,500,000, with equipment. The Frazier-Elm-Sheal Co., Illuminating Bldg., Cleveland, O., is engineer.

Mississippi

MAGNOLIA—The Magnolia Cotton Oil Co. has plans under way for the erection of a new 1-story plant.

Missouri

HILLSBORO—The Apt Co., 3620 West Pine Blvd., St. Louis, Mo., will build a 1-story foundry in connection with its proposed local works for the manufacture of railroad specialties, castings, etc. W. E. Apt is president.

GRANITE CITY—The Union Starch & Refining Co., Edinburg, Ind., has taken title to the local plant of the Temtor Corn & Fruit Products Co., recently acquired for a consideration said to be about \$1,000,000, and will take possession at once. Improvements will be made and operations commenced at an early date for the manufacture of glucose and other kindred products. The purchasing company will increase its working capital, and will establish headquarters at the local plant. It is purposed to discontinue operations at the Erinburg works.

Nevada

BATTLE MOUNTAIN—The Cortez Silver Co. has construction under way on a new mill with capacity of 100 tons per day, and plans to have the unit ready for service in the near future. The output will be increased to 150 tons with the installation of additional machinery shortly thereafter.

New Jersey

NEW BRUNSWICK—The Public Service Gas Co., Public Service Terminal, Newark, has acquired a tract of about 48 acres of property on the Raritan River, Raritan Township, as a site for a new artificial gas plant, with gross capacity of about 10,000,000 cu ft. per day. It is estimated to cost in excess of \$250,000.

NEWARK—The Essex County Highway Department is planning for the installation of a chemical laboratory for testing service. Space in a local building has been arranged for the purpose.

PISCATAWAY—The Middlesex Hollow Tile Co., 215 Rector St., Perth Amboy, recently organized with a capital of \$100,000, has acquired the local plant of the Kelso Clay Products Co., and will use the works for the production of hollow tile. Operations will be placed under way at once. John G. Fritzinger, formerly connected with the National Fireproofing Co., heads the new organization. Other officials are John H. and C. E. Fritzinger.

GLOUCESTER CITY—The City Council is arranging a bond issue of \$80,000, the larger portion of the proceeds to be used for the installation of a filtration plant at the municipal waterworks. A contract will be awarded in the near future.

New York

BATAVIA—The plant of the Batavia Rubber Co. has been acquired at a receiver's sale by the Taylor, Armistage & Eagle Co., 120 Broadway, and the Fred Stearns Co., 1832 Broadway, both of New York. The new owners have made a joint agreement to operate the plant for the manufacture of automobile tires, and will place the works in service at an early date. Improvements will be made.

RICHMOND HILL, L. I.—The Unique Leather Goods Co., 125th St. and Jamaica Ave., has filed plans for the erection of a

new 2-story plant, 90x128 ft., estimated to cost about \$85,000. William Higginson, 15 Park Row, New York, is architect.

BATAVIA—The United States Gypsum Co., 205 West Monroe St., Chicago, Ill., has taken title to a tract of gypsum property at Oakfield, near Batavia, totaling about 1,000 acres, and plans for the early development of the site. It is said that a new plant will be built at a later date.

NEW YORK—The Board of Trustees, Columbia University, Morningside Heights, has plans nearing completion for the proposed new chemical engineering and chemistry building at the institution. McKim, Mead & White, 101 Park Ave., are architects.

North Carolina

CHARLOTTE—The Aiken Mfg. Co., 728 East 7th St., recently organized with a capital of \$100,000, has acquired a local plant for the manufacture of polishes and kindred specialties. The present factory will be enlarged and additional equipment installed at an early date. L. S. Sloop is president.

Oklahoma

SAND SPRINGS—The Mid-Chemical Co. has perfected arrangements for a local plant for the manufacture of chemicals and chemical byproducts. O. E. Oesterlie, Henryetta, Okla., is one of the heads of the company.

SAND SPRINGS—The du Pont Powder Co. has broken ground for the construction of a local plant for the manufacture of a line of powder specialties.

Pennsylvania

PITTSBURGH—The Metal & Thermit Corp., 120 Broadway, New York, manufacturer of metals, alloys, etc., is taking bids for the erection of a new 2-story plant, 40x100 ft., on Fayette St. H. D. Kelly, 801 Hillsboro Ave., is local representative.

PHILADELPHIA—The Abrasive Co., Tacony and Fraley Sts., manufacturer of grinding wheels and other abrasive products, has awarded a contract to the Pittsburgh-Des Moines Steel Co., 30 Church St., New York, for the erection of a 1-story addition.

WILKES-BARRE—A 1-story pressing and drying building at the plant of the du Pont Powder Co., Oliver Mills, near Wilkes-Barre, was destroyed by fire, Nov. 16, caused by an explosion.

FULLERTON—The Lehigh-Fuller Co., has tentative plans under way for the rebuilding of the portion of the foundry at its machinery manufacturing plant destroyed by fire, Nov. 13, with loss estimated at about \$35,000, including equipment.

PHILADELPHIA—The American Insulation Co., Stokley St., manufacturer of asbestos products, has awarded a contract to the William Steele & Sons Co., 1600 Arch St., for the erection of a 1-story building at its plant to cost about \$25,000.

CEMENTON—The Whitehall Portland Cement Co. will build an addition to its storage and distributing plant, and make other mill improvements.

PHILADELPHIA—The Pennsylvania Sugar Co., Delaware Ave., has plans under way for the erection of a new group of buildings at its local refining plant.

South Carolina

CLOVER—The Clover Cotton Oil & Gln Co. has been organized by J. F. Pursley, for the operation of a local mill for the production of cotton oil and fertilizer products. Plans are in progress for the plant, to total about 5,000 sq. ft. of floor space and to be equipped for a daily output of 100 tons of material.

Tennessee

CHATTANOOGA—The Gager Lime & Mfg. Co. is planning for the installation of additional equipment at its plant, including washing machinery, crushers, etc. M. P. Kenney is secretary.

Texas

CISCO—The local oil refinery of the Liberty Oil Co. has been acquired by new interests, headed by L. H. Christman, Dallas. The new owners plan for immediate enlargements, including the installation of additional equipment, estimated to cost approximately \$50,000. The output will be increased to 3,000 bbl. daily.

SHERMAN—The Buffalo Refining Co., recently organized, has purchased the local oil refinery of the Buffalo Products & Refining Co., with capacity of 400 bbl. per day, and will take immediate possession. Improvements will be made and the plant placed in service. F. M. Thompson and D. L. Cooke head the new organization.

HUMBLE—Fire, Nov. 12, destroyed a large portion of the local tank farm of the Gulf Production Co., with loss estimated in excess of \$300,000, including equipment.

West Virginia

NITRO—The Rubber Service Laboratories, Inc., is planning for the rebuilding of the portion of its local plant, recently destroyed by fire with loss estimated at about \$75,000, including equipment. B. Carl Hand is general manager.

NITRO—The Charleston Paper Mfg. Co. has work under way on a new plant, comprising the remodeling of an existing building, for a new paper mill. It is planned to install equipment at an early date.

INWOOD—The Valley Evaporating Co. has tentative plans under consideration for the rebuilding of the portion of its plant recently destroyed by fire. An official estimate of loss has not been made.

Wisconsin

RACINE—The Belle City Malleable Iron Co., is razing an existing building on local plant site, preparatory to the erection of a new 1-story annealing works, 75x153 ft., for which plans have been completed.

New Companies

KAHLBAUM-KIRBACH, INC., New York, N. Y., care of C. S. Aronstam, 120 Broadway, New York, representative, has been incorporated with a capital of \$50,000, to manufacture chemicals and chemical byproducts. The incorporators are A. H. Appel, H. Pleus and F. R. Fox.

THE BARNES ZINC CO., Eighth and Union Sts., La Salle, Ill., has been incorporated with a capital of \$100,000, to manufacture zinc and kindred metal products. The incorporators are C. B. O'Neil, Frank Page and Harold Beacon.

THE LITTLE FALLS CHEMICAL CO., Little Falls, N. J., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture chemicals and chemical byproducts. The incorporators are E. C. Fox, Louis Van der Meer and Justus C. Herstein, Little Falls. The last noted represents the company.

THE GENERAL EXPLOSIVES CO., Wilmington, Del., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, has been incorporated under state laws to manufacture explosives, powder, etc., with capital of \$1,000,000.

THE KEN OIL CORP., Binghamton, N. Y., has been incorporated with a capital of \$50,000, to manufacture oil products. The incorporators are T. G. O'Brien, J. L. Weir and H. D. Ballard. The company is represented by Mangan & Managan, Binghamton.

THE STEVENS PAPER MILLS, INC., Rainbow, Windsor, Conn., recently incorporated, has been organized with a paid in capital of \$50,000, to manufacture paper products. C. N. Stevens, New Rochelle, N. Y., has been elected president; and George C. Russell, Hartford, Conn., vice-president.

THE ATTOYAC OIL CO., Henderson, Tex., has been incorporated with a capital of \$25,000, to manufacture petroleum products. The incorporators are O. S. Rogers, R. T. Forman and A. C. Wylie, all of Henderson.

THE NELSON PRODUCTS CO., Room 637, 111 West Washington St., Chicago, Ill., has been incorporated with a capital of \$25,000, to manufacture colors, chemicals, etc. The incorporators are George C. Hager, R. D. Clay and H. C. McVeigh.

THE LIQUID LIGHTNING CO., Portland, Ore., has been incorporated with a capital of \$5,000, to manufacture compounds for batteries and other purposes. W. A. Carter, 1212 Gasco Bldg., Portland, is the principal incorporator.

THE BUCKEYE COPPER CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., has been incorporated under Delaware laws with capital of \$20,000,000, to produce refined copper and other metals.

THE SEPOY COLOR & CHEMICAL CO., Jersey City, N. J., care of the Corporation Trust Co., 15 Exchange Pl., Jersey City, representative, has been incorporated with a capital of 1,500 shares of stock, no par value, to manufacture colors, chemicals and chemical byproducts.

THE PURITY CHEMICAL CO., Boston, Mass., has filed notice of organization to manufacture chemicals and chemical byproducts. The company is headed by Milton Ackerman and Ralph A. Bowen, 11 Stover St., Boston.

THE A. B. MASSA PAPER CORP., New York, N. Y., care of Knox & Dooling, 37 West 43rd St., New York, representatives, has been incorporated with a capital of \$25,000, to manufacture paper products. The incorporators are A. B. and L. V. Massa.

THE ELECTRO-PLATING CO., Huntington, W. Va., has been incorporated with a capital of \$5,000, to operate a metal-plating works. The incorporators are Louis and B. Klammer, Maurice Rosen and I. Benjamin Romer, all of Huntington.

THE EDWARDSVILLE CHEMICAL CO., Troy Rd. and 3rd St., Mahler Heights, near Edwardsville, Ill., has been incorporated with a capital of \$5,000, to manufacture chemicals and chemical byproducts. The incorporators are Charles F. Scholl and Edward Koenig.

THE ARKANSAS-MARUCOPA OIL CO., Fulton, Ky., has been incorporated with a capital of \$75,000, to manufacture petroleum products. The incorporators are W. E. Simmons, W. W. Gourley and J. T. Linton, all of Fulton.

THE BETHEL TANNING CO., INC., Bethel, Conn., recently incorporated, has been organized with headquarters at 146 Center St., to manufacture leather. Howard E. Mackenzie has been elected president; F. H. Judd, vice-president; and Charles H. Hart, secretary and treasurer.

THE COATING SPECIALTIES CO., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, has been incorporated under Delaware laws with capital of \$50,000, to manufacture paints, varnishes and kindred products.

THE BERKSHIRE TALC PRODUCTS CORP., Newark, N. J., care of Harry Unger, 207 Market St., Newark, representative, has been incorporated with a capital of \$125,000, to operate talc properties and manufacture refined talc products. The incorporators are Harold Shuster, Frederick G. Rose and George E. Ebehalt.

THE HUB CHEMICAL CO., Boston, Mass., has filed notice of organization to manufacture and deal in chemicals and chemical byproducts. The company is headed by John B. Lewis, 54 Thayer St., Boston.

WALTER SHUTTLEWORTH, INC., New York, N. Y., care of R. S. Nichols, 141 Broadway, New York, representative, has been incorporated with a capital of \$150,000, to manufacture paper products. The incorporators are E. G. and W. E. Shuttleworth, and H. Comiskey.

THE R. L. GLASSON CHEMICAL CO., Seymour, Ind., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of \$100,000, to manufacture chemicals and chemical byproducts. The incorporators are Reuben Glasson and Charles F. Quade, both of Seymour.

THE STRATFORD CO., Morganville, N. J., care of James F. Farrell, Morganville, representative, has been incorporated with a capital of \$1,000,000, to manufacture arsenic acid and other acids and chemicals. The incorporators are Julius Midas, Peter von der Hyde and James L. Ryan.

THE FIT FORM MFG. CO., New York, N. Y., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., has been incorporated under Delaware laws with capital of \$1,250,000, to manufacture bottles and other glass containers. The incorporators are William F. Dermott, New York; Patrick M. Kelly, Jersey City, N. J.; and Theodore L. Harrison, Ridgefield Park, N. J.

THE INTERSTATE RUBBER CO., New York, N. Y., care of Nathan Permut, 82 Duane St., New York, representative, has been incorporated with a capital of \$20,000, to manufacture rubber products. The incorporators are G. A. and J. E. Conklin.

THE AMERICAN ELECTRO-PLATING WORKS, INC., Somerville, Mass., has been incorporated with a capital of 100 shares of stock, no par value, to operate a metal plating plant. John J. Walsh, Ames Bldg., Boston, is treasurer and representative.

THE GREENWICH CHEMICAL CO., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, representative, has been incorporated under Delaware laws, with capital of \$350,000, to manufacture chemicals and chemical byproducts. The principal incorporator is Samuel C. Wood, New York.

THE TILE PRODUCTS, INC., New York, N. Y., care of Delamare & Morrison, 140 Nassau St., representatives, has been incorporated with a capital of \$100,000, to manufacture ceramic tile and other kindred burned clay products. The incorporators are F. Sellar, E. L. Hendrickson and H. A. Trent.

Capital Increases, etc.

THE EGYPTIAN LACQUER MFG. CO., Passaic Ave., Kearny, Newark, N. J., has filed notice of increase in capital from \$360,000 to \$720,000, for proposed expansion.

THE UNION PAINT & CHEMICAL CO., Detroit, Mich., has filed notice of dissolution under state laws.

THE ALASKA CHEMICAL CO., 113 West 27th St., New York, N. Y., has filed notice of increase in capital to \$500,000, for proposed expansion.

THE PENNSYLVANIA INDEPENDENT OIL CO., INC., Philadelphia, Pa., care of J. H. Sherman & Co., Bulletin Bldg., Philadelphia, bankers, is disposing of a stock issue of \$440,000, a portion of the proceeds to be used for expansion.

THE VIRGINIA-CAROLINA CHEMICAL CO., Richmond, Va., has arranged for an increase in capital to \$68,000,000, for general expansion and financing.

THE SOUTHERN PAPER CO., Moss Point, Miss., is arranging for a bond issue of \$1,500,000, a portion of the proceeds to be used for expansion.

THE HARDY CHEMICAL CO., Norwalk, Conn., has filed a preliminary certificate of dissolution under state laws.

THE PETROLEUM OIL CO., Anderson, S. C., is arranging for an increase in capital to \$100,000, for proposed expansion. Charles A. Gambrell is president.

THE MAGNOLIA PETROLEUM CO., Galveston, Tex., operating oil refineries, has called a meeting of stockholders, Dec. 2 to approve an increase in capital from \$120,000,000 to \$180,000,000, a portion of the proceeds to be used for expansion.

The referee in bankruptcy for the CHOAT OIL CO., South Robinson St., Oklahoma City, Okla., has arranged for the sale of the refinery of the company, rated at a capacity of 2,000 bbl. per day.

Manufacturers' Catalogs

THE CUTLER STEEL CO., Pittsburgh, Pa., in Bulletin 221 gives a general description of Duralloy, including the development, composition and characteristics, physical properties, strength at high temperatures, machining qualities, welding qualities, oxidation and heat resistance, and corrosion and abrasion resistance.

THE BRISTOL CO., Waterbury, Conn., has issued two new publications: Catalog 1401 contains 68 pages on Pyrometers, while Bulletin 311 contains 12 pages on Bristol's Class II Recording Wet- and Dry-Bulb Thermometers.

THE HOLDECK ENGINEERS CO., Marshall Bldg., Cleveland, O., has issued a bulletin on pulverized coal as applied to the malleable iron and air furnace iron industry.

THE CALORIZING CO. OF PITTSBURGH, PA., calls attention to Bulletin 2, on Calite Castings, for use in high temperatures. Calite castings are made under patents of the General Electric Co. at its Lynn, Mass., foundry and are sold by the Calorizing Co. of Pittsburgh. This 16-page booklet gives interesting illustrations and descriptive matter on the reason for Calite, the high-temperature range, why it lasts, resistance to corrosive gases, strength, physical properties, uses, etc.

B. F. STURTEVANT CO., Hyde Park, Boston, Mass., has published Bulletin 299, on unit driers. This type of drier consists of a motor-driven fan, the air from which passes over heater coils and is then discharged into a cabinet. Practically any desired temperature and velocity of air can be obtained for the correct drying of a particular material. These driers are made in various sizes, from the size which may be set on a bench to the size into which may be wheeled a number of trucks holding several trays of the material to be dried. Where the material is of such a nature that trays are not necessary, suitable methods of suspension are fitted into the cabinet accordingly. Copy of this bulletin will be sent on request.

THE VITREFRAX CO., Los Angeles, Calif., announces a new publication entitled "The Irreducible Volume." After a general description of Vitrefrax and the scope of the Vitrefrax process, there follows information on the nature and application of refractories in general and of Vitrefrax super refractories in particular.

THE CONNERSVILLE BLOWER CO., Connerville, Ind., calls attention to Bulletin 4, on rotary displacement meters.

THE LINK-BELT CO., Chicago, Ill., announces the completion of a new general catalog, No. 400, which embraces its entire line. It is the most complete book the company has ever issued, containing 932 pages,

and is cloth bound. Copies can be obtained from any Link-Belt office. The catalog not only includes the complete Link-Belt line but also the products of the H. W. Caldwell & Son Co. plant of that company. The following is a brief summary of the contents covered in the catalog: Chains and wheels, power transmission machinery, bearings, hangers, take-ups, gears (machine molded or cut-tooth), clutches, pulleys, sheaves, elevator boots, buckets, casings, helioid and other screw conveyor equipment, gates for conveyors, bins, hoppers, etc., steel apron conveyors, belt conveyors, Peck carrier, boiler plant equipment, coal tipple equipment, coal washeries, jigs, elevators, driers, coal storage, pockets, tramways, towers, locomotive coaling stations, car loaders and unloaders, portable loaders, portable belt conveyors, locomotive and crawler type cranes, grab buckets, wood grapples, etc., electric hoists, overhead cranes, telferage, car pullers, friction hoists, power hoes, power shovels, cable haulage, sand and gravel washing equipment, revolving screens, sand separators, etc., lime-handling equipment, foundry conveyors, sand revivifiers, elevators and conveyors for glass plants, canneries, freight handling and sugar plantation and refinery machinery.

LEE B. METTLER CO., fuel efficiency engineers, Los Angeles, Calif., has issued a pamphlet entitled "In Response to a Demand." This pamphlet treats of the Mettler silicon-carbide refractory, surface-combustion burner, the surface combustion unit and the stack-damper indicator.

THE SEMENT-SOLVAY CO., Syracuse, N. Y., in a new publication tells of its progress of 30 years, of the byproduct oven and the manufacture of city gas, byproduct gas ovens, advantages of byproduct coke and gas ovens and byproduct recovery apparatus. Interesting photographs of actual plants are given, as well as the general arrangement of a byproduct gas oven plant, diagram of oven draft for single-pass regenerators and the Sement-Solvay gas flow chart.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its winter meeting at Richmond, Va., Dec. 7 to 9. Headquarters will be at the Hotel Jefferson.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stettens Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

NEW JERSEY CLAY WORKERS' ASSOCIATION will hold its annual meeting at the Ceramics Building, Rutgers College, New Brunswick, Dec. 12.

SOCIETY OF CHEMICAL INDUSTRY, American Section, will meet in Rumford Hall, 52 East 41st St., New York City, on Dec. 15.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.